Appendix M

North Bend Gravel Operation Transportation Technical Report

NORTH BEND GRAVEL OPERATION
TRANSPORTATION TECHNICAL REPORT

For

KING COUNTY
URS JOB NO.: 53-42279001.00
December 12, 2001

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1.0 INTRODUCTION

This technical report addresses the potential impacts on traffic and transportation facilities from the proposed development of a gravel extraction and processing operation on the east side of North Bend, Washington. Cadman, Inc. has applied to the King County Department of Development and Environmental Services (DDES) for a permit to mine sand and gravel on two sites, approximately 693 acres in total size. The sites are located north of Interstate 90 (I-90) and east of 468th Street/Exit 34, just east of the city of North Bend. According to Cadman, Inc.'s proposal, mineral extraction from the Lower Site would occur first with subsequent conversion into a processing center for Upper Site (Grouse Ridge) material. The anticipated life span of the mine is approximately 25 years. Mining operations would occur in three phases with extraction of the Upper Site likely occurring on no more than 50 acres at any one time. Impacts would be quantitatively assessed for four project alternatives.

1.1 ALTERNATIVES

1.1.1 Proposal

The proposal includes a mining plan (as described above) where gravel from the Lower Site would be extracted and processed at other locations. After extraction at the Lower Site is complete, part of the depression area would be developed to process gravel extracted from the Upper Site. Gravel from the Upper Site would be conveyed down the west slope of Grouse Ridge to the Lower Site for processing. Overburden soils would be used to establish berms for visual and noise buffering at both site locations.

A long-term lease with Weyerhaeuser Company secures Cadman, Inc.'s rights to the project site. After mining is completed, and the site is graded and revegetated, Weyerhaeuser has committed to donating the entire mineral resource site to public ownership. The terms of the agreed donation require the reclaimed mining site to remain as forested in perpetuity. Four different alternatives are envisioned for the North Bend Gravel Operations Project. They are briefly described below. Several of the alternatives are divided into distinct operational phases with differing products, production levels and machinery used. For the Proposal and all alternatives it was assumed that the facility would operate from 5:30 a.m. to 10:30 p.m., Monday through Saturday, 306 days per year. Truck hauling would occur 24 hours a day Monday through Saturday.

1.1.2 Alternatives

Development of a gravel extraction and processing operation has been proposed by Cadman, Inc. on land located east of the City of North Bend, in unincorporated King County. Four development alternatives, including No Action, have been defined for the land, and are the basis for the environmental analyses of the transportation elements presented in this technical report:

1.1.2.1 Alternative 1–No Action

No action conditions.

1.1.2.2 Alternative 2–Proposal: Lower and Upper Sites Mining - Exit 34

The Alternative proposed by Cadman, Inc. involves development of two separate areas of the land, referred to as the Lower Site (Edgewick) and the Upper Site (Grouse Ridge), for gravel extraction and processing. There is also a Lower Site Option that is essentially the same operations as for the Lower Site but with a smaller footprint. Operations would include the excavation, washing, crushing, sorting, and stockpiling of sand and gravel. Construction of concrete and asphalt batch plants at the Lower Site may occur depending on market conditions in conjunction with excavation of the Upper Site. Extraction would initially occur only in the Lower Site, with material hauled by truck from the site via I-90 at Exit 34. Material from the Upper Site would be moved to the Lower Site using a 36- to 42-inch-wide conveyor along the west slope of Grouse Ridge.

1.1.2.3 Alternative 2A–Upper Site Mining and Limited Lower Site Mining - Exit 34

Cadman, Inc., has included this option to decrease the footprint of the Lower Site's gravel operations to keep the operations at least 1/4 mile from the nearest residence. The amount of gravel to be removed will be reduced accordingly.

1.1.2.4 Alternative 3–Lower and Upper Sites - Exits 34 and 38

Gravel extracted from the Lower Site (Edgewick) and for the Lower Site Option would be transported from the site via Exit 34 similar to Alternative 2. After extraction has been completed in the Lower Site, the Upper Site (Grouse Ridge) would then be developed, with material hauled out via I-90 at Exit 38 using SE Grouse Ridge Road. Aggregate processing would take place on the Upper Site. The concrete and asphalt batch plants, supplied by trucks from the Upper Site, would be located at the Lower Site, if they are built. The alternative does not include a conveyor line between the Lower and Upper Sites.

1.1.2.5 Alternative 3A–Upper Site Mining and Limited Lower Site Mining - Exits 34 and 38

Lower Site Option. Cadman, Inc., has included this option to decrease the footprint of the Lower Site's gravel operations to keep the operations at least 1/4 mile from the nearest residence. The amount of gravel to be removed will be reduced accordingly.

1.1.2.6 Alternative 4–Upper Site Mining - Exit 38

Under this alternative, the Lower Site would not be excavated or developed. Extraction and aggregate processing would occur only at the Upper Site (Grouse Ridge), with processed material hauled out to I-90 at Exit 38 via SE Grouse Ridge Road. Onsite concrete and asphalt batch plants are not to be included in this alternative.

1.2 STUDY AREA

The gravel mining operation is proposed to take place on land located east of the City of North Bend, Washington in unincorporated King County. The land is owned by Weyerhaeuser Company and leased to Cadman, Inc. Two separate sites would be leased for the proposed development. The Lower Site is located north of I-90 and east of 468th Avenue SE off SE 146th Street. The Lower Site is about 115 acres. The Upper Site is located north of I-90 on the Grouse Ridge plateau off SE Grouse Ridge Road, and is about

578 acres. The two sites are approximately 1 mile apart. The Upper Site is approximately 900 feet higher in elevation than the Lower Site.

The traffic and transportation study area includes the two leased sites (approximately 693 acres) and the local roadways connecting the sites, including I-90 from Exit 32 through Exit 38. Figure 1 illustrates the geographic boundaries of the study area and roadways considered in this analysis. The traffic and transportation impacts within this technical report are limited to that study area. The study area includes the following interchanges, roadways and highways in the vicinity of the proposed mining operation sites:

- Exit 38 (West Homestead Valley Road Interchange)
- Exit 38 (East Garcia Interchange)
- Exit 34 (at 468th Avenue SE or Edgewick Road Interchange)
- Exit 32 (at 436th Avenue SE)
- SE North Bend Way between 468th Avenue SE (Exit 34) and 436th Avenue SE (Exit 32)
- SE 140th Street between 468th Avenue SE and SE SE North Bend Way
- SE 146th Street (east of 468th Avenue SE)
- 468th Avenue SE (SE 140th Street to I-90 (Exit 34))
- I-90 between Exit 32 and Exit 38 (East)
- SE Grouse Ridge Road (to Exit 38 East)

1.3 METHODOLOGY

This report provides a current traffic baseline for the transportation study area. In addition, it forecasts future traffic conditions in the study area under each of the project's four alternatives. For each of the action alternatives, the report evaluates the impact of mining operation, and truck and employee traffic on I-90 interchanges, and the local roadways, using the methodology described below. The No Action Alternative includes all currently approved planned (May 1999 or earlier) land uses and facility improvements in the study area.

In addition to traffic analysis, this report evaluates the consistency of the proposed mining operation's traffic impacts with applicable Washington State Department of Transportation (WSDOT) plans for I-90, the City of North Bend Comprehensive Plan, and the King County's Transportation Needs Report. It also addresses issues related to emergency vehicle response times, regional bus service, and pedestrian and bicycle traffic. General evaluations of the proposed mining operation's impact on pavement conditions, and traffic accidents in the project area are also included.

The technical report concludes by identifying measures to mitigate impacts of the three action alternatives. It also documents unavoidable adverse impacts associated with the alternatives.

2.0 AFFECTED ENVIRONMENT

Cadman, Inc. is proposing to mine gravel from a site located northeast of the I-90/468th Avenue SE (Edgewick Road) interchange (Exit 34). Access to this site would occur along an existing roadway (SE 146th Street) that then intersects with 468th Avenue SE. Access would continue along 468th Avenue SE south approximately 600 feet to the I-90 westbound on- and off-ramps (see Figure 2).

Initially, the Lower Site would be used to supply direct sales of unprocessed materials to its customers and other Cadman, Inc. facilities. In the future, as market conditions allow, a concrete batch facility and/or an asphalt batch facility could be built on the site. For the purpose of the concurrency analysis, all potential operations are included in the trip generation estimate.

At its peak, the Lower Site is expected to process up to 2.1 million tons of gravel, 170,000 cubic yards of concrete, and 150,000 tons of asphalt each year. Volume during the peak construction season month typically represents about 15% of the annual production. The site would employ approximately 20 people at full production.

2.1 HIGHWAY AND STREET SYSTEMS

2.1.1 Existing Conditions

The City of North Bend is located about 30 miles east of Seattle, Washington. The main transportation corridors are I-90, which provides access to the east and west, and SR 202, which provides access to the neighboring cities of Snoqualmie and Redmond. Bus (transit) service is provided by Metro, a division of King County, to Seattle and other communities in the Snoqualmie Valley.

In small urban areas such as North Bend, streets and highways are classified according to their designated function. Principal arterials serve major centers of activity, accommodate the highest traffic volumes, and provide for the longest trip length. Minor arterials augment the principal arterials, place more emphasis on access with lower mobility, and accommodate trips of moderate length. Collector streets provide access within residential neighborhoods and collect traffic from local streets in a neighborhood and channel it into the arterial street system. Local streets provide access to adjacent parcels and are not intended to provide significant through traffic.

Principal arterials in the City of North Bend in the vicinity of the project are SE North Bend Way from 436th Avenue SE to 468th Avenue SE, and 436th Avenue SE from SE North Bend Way to I-90 (See Figure 1). Table 1 lists major streets in the study area that could be affected by the proposed North Bend Gravel Operation project.

TABLE 1
EXISTING ROADWAY CHARACTERISTICS

Location	Road Type	Average Lane Width (feet)	Average Shoulder Width (feet)	Pavement Type	Sidewalk
SE SE North Bend Way, West of 436th Avenue SE	Two-lane	10.5	8	Asphalt	No
SE SE North Bend Way, East of 436th Avenue SE	Two-lane	10.5	5.5	Asphalt	No
436th Avenue SE, North of I-90 WB Ramps	Two-lane	11	8	Asphalt	No
436th Avenue SE, South of I-90 EB Ramps	Two-lane	11	10	Asphalt	No
SE Middle Fork Road, East of 468th Avenue SE	Two-lane	11.5	7	Asphalt	No
468th Avenue SE, North of SE 144th Street	Two-lane	11.5	4	Asphalt	No
SE 144th Street, East of 468th Avenue SE	Two-lane	13	0	Gravel & Dirt	No
468th Avenue SE, SE 144th Street to I-90 Ramps	Two-lane	14	6	Asphalt	Some
SE 146th Street, East of 468th Avenue SE	Two-lane	12	8	Asphalt	Yes (8 feet)
SE SE North Bend Way, West of 468th Avenue SE	Two-lane	12.5	3	Asphalt	No
I-90 WB On-Ramp at 468th Avenue SE	Ramp	15	5.5	Asphalt	No
I-90 WB Off-Ramp at 468th Avenue SE	Ramp	18	8.5	Asphalt	No
Between I-90 Ramps at 468th Avenue SE	Two-lane	13	7.5	Asphalt	No
I-90 EB Off-Ramp at 468th Avenue SE	Ramp	16	11.5	Asphalt	No
I-90 EB On-Ramp at 468th Avenue SE	Ramp	21	5	Asphalt	No
468th Avenue SE, South of I-90 EB Ramps	Two-lane	11	10	Asphalt	No
SE Homestead Valley Road, West of Exit 38 West	Two-lane	14	0	Asphalt	No
SE Homestead Valley Road at Olallie Entrance	Two-lane	12	Soft Shoulder	Asphalt	No
SE Grouse Ridge Road, East of Bridge	One-lane	14	0	Asphalt	No

2.1.2 Lower Site Access

Figure 2 shows streets and businesses in the vicinity of the Lower Site. The proposed project's access for the Lower Site on SE 146th Street is paved for approximately 850 feet from 468th Avenue SE east and has 8-foot-wide sidewalks on both sides. Edgewick Inn has two drives on the south side of SE 146th Street and the BP/Pizza Hut/Taco Bell complex has one drive on the north side close to 468th Avenue SE.

468th Avenue SE is a two-lane road with some shoulders of varying width but no turn lanes. It is bordered by a sidewalk on the east side only from SE 146th Street north to SE 144th Street. North of SE 144th Street, 468th Avenue SE curves west and has little or no shoulder, with trees and fences along its edges. Streetlights exist only at isolated intersections. Along 468th Avenue SE there are fire hydrants along the east side and no parking signs on the west side. An open ditch is in front of part of Seattle East Auto Truck Plaza (formerly Ken's Truck Town) on the west side. Trucks exiting the Seattle East Auto Truck Plaza and turning southbound onto 468th Avenue SE cross over into the northbound lane. Development along the road is mostly commercial south of SE 144th Street to SE North Bend Way and light industrial north of SE 144th Street. SE Middle Fork Road tees into 468th Avenue SE as 468th Avenue SE heads north and west.

Just to the east of the tee along the north side of SE Middle Fork Road is the site of the proposed middle school and elementary school (see Figure 2). At the tee heading west, 468th Avenue SE becomes SE 140th Street (a 35-mph road with gravel or no shoulders) that serves a residential area before connecting back into SE North Bend Way. Local truck traffic was observed on SE 140th Street.

SE North Bend Way is a high-speed (50-mph) arterial that starts at 468th Avenue SE and heads west into central North Bend. It is two lanes wide with paved 6-foot shoulders and is a truck route. It serves commercial, office, industrial and residential property. Speed limits gradually decrease to 25 mph as it enters the City of North Bend. 468th Avenue SE to the south connects SE North Bend Way to I-90 at Exit 34 (see Figure 1).

2.1.3 Upper Site Access

SE Grouse Ridge Road is a private road that varies in lane and shoulder widths. The gated roadway was built for and serves the Washington State Patrol Fire Training Academy. Most of the 20-mph road is paved, with a single 14-foot lane intertwined with a few blind curves.

The Washington State Department of Natural Resources (DNR) owns SE Grouse Ridge Road north and west of the bridge over the South Fork of the Snoqualmie River. The Washington State Patrol now owns the bridge, which, along with the road, was built in 1983. From the bridge south to the gate (approximately 1/4 mile) the roadway is owned by Washington State Parks. The single-lane bridge, 137 feet long and 16 feet wide, is posted at 36 tons (see Section 2.7 of this report) weight limit and can carry up to 54-ton trucks (maximum load). The Fire Training Academy staff maintains the entire 2.5 mile roadway (from the gate to the Academy entrance), including snow removal during the winter.

A utility easement runs along the length of SE Grouse Ridge Road from I-90 up to the Washington State Patrol Fire Training Academy, then down a Weyerhaeuser logging road and 468th Avenue SE and into North Bend. The easement contains two underground fiber-optic cables (one AT&T and one MCI/WorldCom), a Puget Sound Energy line, and a PTI telephone line. A third parallel fiber optic cable will be built soon down the middle of SE Grouse Ridge Road.

The Washington State Patrol Fire Training Academy, has 14 full-time employees and many part-time employees and students. The Academy is open and operating from 8:00 a.m. to 5:00 p.m. five days a week December through February, and seven days a week from March through November. The road gate typically opens at 6:00 a.m. and closed at 5:30 p.m. Traffic is usually up the hill by 9:00 a.m. and starts leaving at 3:30 p.m. The posted road speed is 20 mph.

SE Homestead Valley Road, the connecting roadway between east and west Exit 38 of I-90, is a two-lane facility, in fair condition, with mostly paved shoulders. A portion of the roadway needs an overlay and widening for paved shoulders at and east of the Olallie State Park entrance. The asphalt concrete overlay is frequently cracked and slightly rutted in the traffic lanes with occasional transverse reflective cracks from the underlying Portland cement concrete panels. Some of the Portland cement concrete pavement panels are cracked, although the panel joints are tight. This stretch of roadway, approximately 1/4 mile, also has two narrow 20-foot-long bridges, with one bridge 26 feet wide and the other 36 feet wide. Pedestrian and bicyclists travel along this route, especially near the entrance to the state park. West of the park, the speed limit is 50 mph.

2.1.4 I-90

Truck traffic generated by the proposed Action Alternatives would exit the Lower or Upper Sites and enter I-90 at Exits 34 and 38. East of North Bend, I-90 is a high-speed, 70-mph highway heading to the summit at Snoqualmie Pass. It is four lanes wide eastbound and three lanes wide westbound between Exit 34 and Exit 38. In 1998, approximately 26,000 vehicles per day (VPD) used I-90 near Exit 32; 27,000 VPD used I-90 near Exit 34; and 26,000 VPD used I-90 near Exit 38; according to the Washington State Department of Transportation (WSDOT). The Seattle East Auto Truck Plaza at Exit 34 is the first major truck service facility off I-90, on the west side of Snoqualmie Pass. The truck stop serves all traffic, particularly interstate truck traffic and stopped eastbound traffic when I-90 is closed east of North Bend.

2.1.5 Pipeline Projects

Eleven development projects in the vicinity of the Lower Site have been submitted for permit or reviewed at a pre-application meeting with King County. Eight projects would result in 137 single-family residential units; two projects are churches; and one project is an educational facility. Only the residential projects are expected to generate AM or PM peak hour trips that would disperse to many roadways in the site vicinity. Therefore, the increase in traffic on any single roadway is expected to be small. The additional trips generated by proposed developments in the area were accounted for in the future growth rate used for analyses.

Although this report addresses potential traffic impacts of other planned projects in the vicinity of the Proposal on a subjective basis, no attempt has been made to perform quantitative analysis on these projects. Any attempt to quantify the cumulative impacts of these projects at this point would be purely speculative. Consistent with King County policy, the responsibility for evaluating project-specific and area-wide impacts of the projects lies with the applicants at the time they submit their plans to King County for review and approval. Table 2 notes the known current planned projects in the North Bend Area.

TABLE 2
KING COUNTY PIPELINE PROJECTS IN THE NORTH BEND AREA

Status	File	Applicant	Property Address	Use	Single Family	Multi-Family	Square Footage
Permit	95-01-12-02	Chic Land Survey Co. Inc.	41811 SE 141st Street	Single Family Residential	4	0	0
Permit	95-03-21-01	Grace Baptist Church	13520 436th Avenue SE	Church	0	0	9906
Permit	95-10-04-02	Otak	Not Available	Single Family Residential	76	0	0
Permit	96-11-27-01	Gil Lauigueure	157XX 468th Avenue SE*	Single Family Residential	2	0	0
Permit	97-09-19-01	Carl Cangie	13521 432nd Avenue SE	Single Family Residential	4	0	0
Permit	98-08-20-02	Marie W. Ruby	19901 Cedar Falls Road SE	Education Facility	0	0	9868
Permit	98-10-26-01	Plateau Associates	Between SE 166th and SE 141st, North of Cedar Falls Road SE	Single Family Residential	41	0	0
Permit	98-11-13-02	Broweleit Peterson Arch PS	436th Avenue SE between Cedar Falls Way and SE North Bend Way	Church	0	0	30,000
Pre-App	98-11-06-01	Subdivision Management	128XX Mount Si Road*	Single Family Residential	4	0	0
Pre-App	98-11-06-02	Subdivision Management	128XX Mount Si Road*	Single Family Residential	4	0	0
TCM Only	99-07-20-01	Plateau Associates	Snoqualmie Uplands s/o lots 31 and 32	Single Family Residential	2	0	0
Total					**137**	**0**	**49,774**

* Full address not available through King County at this time.

Additional development projects discussed during the public scoping process for this EIS were not included in the pipeline project list at the time it was received. These include the proposed middle and future elementary schools on SE Middle Fork Road east of 468th Avenue SE, and the SE 144th Street industrial park/warehouse distribution center north of the proposed site. Recently, the industrial park/warehouse permit has received approval and is currently under construction.

The Snoqualmie Valley School District has purchased properties on SE Middle Fork Road on which the District proposes to construct an elementary school with an anticipated enrollment of 550 students and a middle school with an anticipated enrollment of 600 students. At this time, the school district has not conducted an environmental review of either of either of the schools and no building permits have been applied for with King County. The volumes for the two future school projects have been incorporated into the EIS traffic analysis even though the schools themselves currently are speculative in nature. The schools are expected to be completed by 2005.

The future weekday peak-hour traffic volumes for the schools and industrial park were estimated using trip generation rates from the Institute of Transportation Engineer's Trip Generation Manual and are shown in Table 3.

TABLE 3
TRIP GENERATION FOR 2005 PROJECTS

Future Weekday Trip Generation			(Total/In/Out)		
Land Use	**Unit**		**ADT[a]**	**AM Peak Total**	**PM Peak Total**
Elementary School (520)	550	Students	561/281/281	165/96/69	143/66/77
Middle School (522)	600	Students	870/435/435	270/154/116	174/89/85
Warehouse (150)	134,400	square feet	844/422/422	101/83/18	92/22/70
Office (710)	32,400	square feet	558/279/279	76/67/9	116/20/96
Totals			**2,833/1,417/1,417**	**612/400/212**	**525/197/328**

[a] Average Daily Trips

The peak hour trips were distributed and added to the background traffic for 2005. The added trips were then projected to increase at the same rate as other background traffic for the years 2015 and 2025 No Action.

.King County has listed seven potential transportation improvement projects in the study area. Three of these are improvements to existing bridges, and the other four are long-range projects that are listed in the Transportation Needs Report as "low priorities." Because they are low priority projects, they may never be constructed. The effect of these projects was not considered in this study.

Below is a list of planned transportation projects by King County.

- CIP #200498: Edgewick Bridge
- CIP #200202: Middle Fork Road
- CIP #200994: Mount Si Bridge
- TNR #SQ 81: 468th Widening, Private, Low Priority
- TNR # SQ 87: 468th/SE 140th, Improve Sight Distance, Realign, Low Priority
- TNR # SQ 94: Equestrian facility on SE 140th St., Low Priority
- TNR # SQ 99: Edgewick Industrial Access Road, Private, Low Priority

North Bend has listed several projects in the City of North Bend Transportation Element of the Comprehensive Plan (1995). None of the projects listed are located within the project area.

2.2 TRAFFIC VOLUMES

2.2.1 Existing Volumes

Intersection traffic counts in the study area were collected in September 1998 by Heffron Transportation and in March/April 1999 and February 2001 by URS (see Table 4) at 13 locations in the study area. The counts were collected over a continuous three day, or 72 hour, period. The Heffron Transportation counts were performed during the week prior to the Labor Day Weekend, and represent one of the highest traffic volume periods of the year. The traffic volumes for Wednesday and Thursday were averaged. Friday volumes were excluded from this analysis since it proceeded the Labor Day weekend, and therefore, represents a high holiday volume condition that occurs only a few times per year. The URS counts were averaged for the three day period in 1999. Vehicle turn movements were observed during morning and evening peak periods (7 to 9 a.m. and 4 to 6 p.m.). The February 2001 counts were conducted during a five-day period, Wednesday through Sunday and reconfirmed previous traffic volumes, including the assumption that weekend traffic was less then weekday traffic.

TABLE 4
TRAFFIC DATA COLLECTION LOCATIONS

Intersection		September 1998	March through April 1999	February 2001
EXIT 32	436th Avenue SE - SE North Bend Way		X	
	436th Avenue SE - I-90 WB Ramps		X	
	436th Avenue SE - I-90 EB Ramps		X	
EXIT 34	468th Avenue SE -140th Street & Middle Fork Road		X	
	468th Avenue SE -SE 146th Street	X		X
	468th Avenue SE - SE North Bend Way	X	X	X
	468th Avenue SE - I-90 WB Ramps	X		X
	468th Avenue SE - I-90 EB Ramps	X		X
EXIT 38	Homestead Valley Road - I-90 WB On-Ramp		X	
	Homestead Valley Road - I-90 EB Off-Ramp		X	
	Homestead Valley Road - I-90 WB Off-Ramp		X	
	Homestead Valley Road - I-90 EB On-Ramp		X	
	Homestead Valley Road - Park Access Road		X	

WB = westbound, EB = eastbound

Vehicle-classification counts were performed for the following locations:

- I-90 Eastbound Off-ramp to 468th Avenue SE
- I-90 Eastbound On-ramp from 468th Avenue SE
- I-90 Westbound Off-ramp to 468th Avenue SE
- I-90 Westbound On-ramp from 468th Avenue SE
- 468th Avenue SE between the interchange ramps
- 468th Avenue SE (Edgewick Road) south of the interchange
- 468th Avenue SE north of the interchange (between ramps and SE North Bend Way)
- 468th Avenue SE between SE 146th Street and SE 144th Street
- SE North Bend Way west of Seattle East Auto Truck Plaza

During the public scoping process, area residents expressed concern that the months when traffic data were collected–September and March–might not be representative of year-round traffic conditions. In particular, they noted that traffic tends to increase significantly during the summer months, and especially on weekends, when people outside the area come to take advantage of recreational opportunities at Olallie State Park. The park entrance is located off SE Homestead Valley Road between Exit 38 East and West.

In 1998, 26,000 vehicles per day (VPD), on average, used I-90 east of North Bend. According to WSDOT's *1997 Annual Traffic Report*, traffic volumes on I-90 in this sector of King County are lower than average in September and in March/April. The peak traffic month for this section of King County and I-90 is July. Seasonal traffic variations are normal, and standard engineering practices provide a means of accounting for them. To ensure that the analysis considered a worst case scenario (such as, highest traffic volumes), an adjustment factor of 17 percent was applied to the September data and 45 percent to March and April data to account for seasonal traffic variations. The result yields traffic volumes equal with those that would be expected in the summer peak period. Figure 3 436th Avenue SE (Exit 32), Figure 4 468th Avenue SE (Exit 34), and Figure 5 SE Homestead Valley Road (Exit 38) show the 1999 peak daily weekday traffic volumes in the study area for the existing conditions.

2.2.2 Future Volumes

The annual traffic growth rates for I-90 and the various roadways within unincorporated King County were established by comparing the September 1998 and March 1999 traffic counts, as adjusted, against available traffic data from 1994, 1995, 1996, and 1997. Background (not project-related) auto traffic is assumed to increase by 2.5 percent per year and truck traffic would increase by 1.5 percent per year.

The background traffic growth rate was applied to current (1999) traffic data to determine the future traffic baseline in order to evaluate the proposed project alternatives. The future traffic baseline is the benchmark against which the project alternatives are evaluated. The traffic generated from the proposed elementary and middle schools, as well as the industrial/office space was added to the projected traffic volumes for the year 2005. This became the new baseline. The traffic projections for years 2015 and 2025 were then developed from the new baseline using the 2.5 percent and 1.5 percent per year growth rates for automobiles and trucks respectively, including the schools and office/industrial volumes. These years provide a basis to evaluate how traffic operations would change during the life of the mine, and provide information related to the likely timing for potential transportation improvements. The peak hour volumes for the No-Action scenarios in the future (2005, 2015, and 2025) are shown on Figure 6, Figure 7, and Figure 8.

2.2.3 Army Convoys

According to the military, Active Army and Reserves convoys traveling through the study area along I-90 use Exit 38 (SE Homestead Valley Road Interchange) as a rest area to stretch, use nearby restroom facilities and re-group. They are allowed a rest period of up to 20 minutes at a paved area just west of the Olallie State Park entrance. This is to ensure that only one convoy is using the rest area at a time.

Active Army convoys generally consists of 5 to 20 vehicles traveling from Fort Lewis to Yakima, Washington. Each convoy is separated by 30 minutes. The maximum number of convoys per day is 10. Oversized and overloaded vehicles travel separately 10 minutes apart at a maximum of 16 vehicles per day. Reserves generally travel during the weekends to and from Yakima. Predicting when and how many convoys travel through the area is nearly impossible. However, their stopping at Exit 38, which is underused, has minimal impact to traffic flow within the study area.

2.3 LEVEL OF SERVICE (LOS)

2.3.1 Methodology

Level of service (LOS) is a measure of the quality of traffic flow. It is rated from A to F, with A representing the best (free-flow) conditions and F representing the worst. The 2000 edition of the *Highway Capacity Manual* (HCM) measures LOS at street intersections in terms of control delay per vehicle in seconds. Control delay is the total elapsed time from a vehicle joining the queue until its departure from the stopped position at the head of the queue. The control delay also includes the time required to decelerate to a stop and to accelerate to the free-flow speed (FFS). The LOS grades are described in more detail below.

- LOS A describes primarily free-flow operations at average travel speeds, usually about 90 percent of the FFS for the given street class. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Control delay at signalized intersections is minimal. Control Delay is ≤ 10 seconds.
- LOS B describes reasonably unimpeded operations at average travel speeds, usually about 70 percent of the FFS for the street class. The ability to maneuver within the traffic stream is only slightly restricted, and control delays at signalized intersections are not significant. Control Delay is >10 to 20 seconds (>10 to 15 seconds for unsignalized intersections).
- LOS C describes stable operations; however, a driver's ability to maneuver and change lanes in mid-block locations may be more restricted than at LOS B, and longer queues, adverse signal coordination, or both, may contribute to lower average travel speeds of about 50 percent of the FFS for the street class. Control Delay is >20 to 35 seconds (>15 to 25 seconds for unsignalized intersections).
- LOS D borders on a range in which small increases in flow may cause substantial increases in delay and decreases in travel speed. LOS D may be due to adverse signal progression, inappropriate signal timing, high volumes, or a combination of these factors. Average travel speeds are about 40 percent of FFS. Control Delay is >35 to 55 seconds (>25 to 35 seconds for unsignalized intersections).
- LOS E is characterized by significant delays and average travel speeds of 33 percent or less of the FFS. Such operations are caused by a combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing. Control Delay is >55 to 80 seconds (>35 to 50 seconds for unsignalized intersections).
- LOS F is characterized by urban street flow at extremely low speeds, typically 25 to 33 percent of the FFS. Intersection congestion is likely at critical signalized locations, with high delays, high volumes, and extensive queuing. Control Delay is >80 seconds (>50 seconds for unsignalized intersection).

Peak hour LOS determinations at the selected intersections were made using the methodology described in the 2000 edition of the *Highway Capacity Manual* using HCS2000 version 4.1 software. This software includes modules for signalized intersections, all-way stop controlled intersections, and two-way stop controlled intersections.

Special adjustments were made for "heavy trucks" with three or more axles to account for their differences in operation characteristics from passenger cars. The *Highway Capacity Manual* and the software consider the average large truck as equivalent to two passenger cars on flat grades, and much greater on uphill grades (varying with the grade). All adjustment tables for effect of grades are keyed to this "default" heavy truck.

Vehicle classification count machines were placed at locations along 436th Avenue SE (Exit 32), 468th Avenue SE (Exit 34), and SE Homestead Valley Road (Exit 38) during the September 1998 traffic count period, and at two of these same locations during the March through April 1999 count period. This equipment determines truck types by number of axles. The average heavy truck currently using the I-90 exits has 4.1 axles and the average heavy truck along I-90 has 4.4 axles. The average heavy truck using these routes is considered roughly equivalent to the HCS "default" heavy truck described in the preceding paragraph.

Trucks much larger than the conventional average would service the project site. Figures 9 and 10 illustrate the largest trucks that would be moving mined materials from the project site northeast of North Bend. It is anticipated that the number of axles per truck would range from 6 to 8.

To assess the impacts of these trucks in highway capacity/operations analysis, the number of project-generated truck trips was doubled to account for trucks coming in empty and leaving full, effectively increasing the "percentage of heavy vehicle" entries overall. The project haul truck is therefore represented as equivalent to four passenger cars (1 empty, 1 full and then increased by a factor of 2 per the *Highway Capacity Manual* resulting in 4 Passenger Car Equivalents (PCE) used in the calculations) on flat grades, and up to eight PCEs (due to factors contained in the *Highway Capacity Manual*) on rolling terrain such as SE Grouse Ridge Road. These calculations result in a worst case scenario for the number of trucks during the peak hour calculations. Several of the loads will actually only require a one-way trip as they either originate on the site or have the site as a destination.

2.3.2 Peak Hour Analysis

The AM and PM peak commuter hours were selected for LOS analyses. The AM peak hour is from 7 a.m. to 8 a.m. and the PM peak hour is from 4:30 p.m. to 5:30 p.m.

Existing peak hour volumes, which are used to calculate worse case intersection LOS and delays, are shown on Figure 11. Table 5 shows total movement delays, 95% queue length and LOS for the Existing AM and PM peak hour conditions.

TABLE 5
EXISTING PEAK HOUR LEVEL OF SERVICE SUMMARY

Intersection	AM Peak Hour			PM Peak Hour		
	LOS[a]	Delay[b]	95% Q[c]	LOS[a]	Delay[b]	95% Q[c]
SE North Bend Way/436th Avenue SE						
NB Left, & Right	C	23.7	6	F	128.8	26.0
WB Left, & Through	A	7.9	1	A	8.6	1
I-90 WB Ramps/436th Avenue SE						
WB Left & Through	F	77.0	1	E	38.9	1
WB Right	B	11.1	1	B	11.6	1
NB Left	B	10.2	3	A	9.6	1
I-90 EB Ramps/436th Avenue SE						
EB Left & Through	C	24.3	1	E	42.4	5
EB Right	A	9.1	1	E	39.3	13
SB Left	B	10.3	1	A	8.5	1
Middle Fork Road/468th Avenue SE						
WB Left, & Right	A	9.3	1	A	9.4	1
SB Left, & Through	A	7.4	1	A	7.6	1
SE 146th Street/468th Avenue SE						
EB Left, Through, & Right	A	9.7	1	B	10.3	1
WB Left, Through, & Right	B	11.3	1	B	13.5	1
NB Left, Through, & Right	A	8.4	1	A	8.7	1
SB Left, Through, & Right	A	7.4	1	A	7.5	1
SE North Bend Way/468th Avenue SE						
EB Left, & Right	B	10.7	1	B	11.5	1
NB Left, & Through	A	8.0	1	A	7.8	1
I-90 WB Ramps/468th Avenue SE						
WB Left, Through, & Right	A	9.9	1	B	10.7	1
NB Left, & Through	A	7.6	1	A	7.8	1
I-90 EB Ramps/468th Avenue SE						
EB Left, Through, & Right	B	10.5	1	C	16.4	2
SB Left, & Through	A	7.9	1	A	8.1	1

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds.
[c] 95% Q = 95th percentile queue estimate in vehicles.
NB = northbound, WB = westbound, EB = eastbound, SB = southbound
Note: Only Critical Movements shown. Those movements without stop control have free-flow through intersection and are not represented here.

All movements at intersections along 468th Avenue SE (Exit 34) operate at LOS B or better under existing conditions for both the AM and PM peak hours, with the exception of the eastbound movements at 468th Avenue SE and I-90 EB ramps which operates at LOS C in the PM peak hour. However, intersections along 436th Avenue SE (Exit 32) have at least one driving “movement” (left turn, right turn, or through) that operates at LOS E or worse in either the AM or PM peak hour. Higher volumes at unsignalized intersections cause such traffic flows.

Existing intersections at SE Homestead Valley Road (Exit 38) are underutilized and operate at LOS A.

2.3.3 Mitigation Peak Hour Analysis

In addition to the *Highway Capacity Manual* intersection analysis and the corresponding Highway Capacity Software, an additional traffic analysis was performed. VISSIM is a traffic analysis software that simulates how traffic will operate through an entire system of intersections and is capable of visually displaying the outcome. The purpose of the VISSIM analysis is to help determine the most appropriate mitigation measures based on the impacts of the Proposal (Alternative 2).

The VISSIM analysis was performed only for the Proposal (Alternative 2) and only within the direct impact areas of the Proposal. Therefore, intersections along 468th Avenue SE between the I-90 eastbound ramps and SE 146th Street were analyzed. Results of the HCS analysis and the VISSIM analysis are compared in Tables 6, 7, 9, 10, 11, 12, 13, 22, 23, 24, and 25.

Several different mitigation scenarios were analyzed using VISSIM to help determine the most beneficial mitigation for the transportation system with respect to the Proposal. As a baseline, the 2005 and 2025 forecast years were modeled without the project. Then the 2005 and 2025 forecast years were modeled including the traffic generated by the project. Finally, differing levels of mitigation, ranging from adding lanes to adding signals, were modeled to evaluate mitigation options. The results of the VISSIM analysis are presented in Section 3 Environmental Impacts.

2.4 ACCIDENT HISTORY

2.4.1 Accidents on Local Streets

A review of traffic accidents on the major streets within the project area under both King County and WSDOT jurisdiction was completed. Accident data from King County for 1992 to 1999 shows 12 accidents at intersections on 468th Avenue SE and 14 accidents at intersections on SE North Bend Way, as listed below.

- SE 140th Street and 468th Avenue SE, two accidents
- SE 146th Street and 468th Avenue SE, one accident
- SE Middle Fork Road and 468th Avenue SE, two accidents
- SE North Bend Way and 468th Avenue SE, one accident
- SE 144th Street and 468th Avenue SE, two accidents
- SE 160th Street and 468th Avenue SE, one accident
- SE 153rd Street and 468th Avenue SE, three accidents
- SE North Bend Way and SE 140th Street, four accidents
- SE North Bend Way and 452nd Avenue SE, two accidents

2.4.2 Accidents on I-90

WSDOT provided information for I-90 at the two interchanges within the study area (I-90 at 435th Avenue SE and I-90 at 468th Avenue SE) for January 1, 1998 through December 31, 2000. For I-90 at 436th Avenue SE, there were 12 accidents reported for this period (2 in 1998, 7 in 1999 and 3 in 2000) totaling 8 injuries and no fatalities. For the intersection of I-90 and 468th Avenue SE, a total of 19 accidents were reported for the same period (8 accidents in 1998, 10 accidents in 1999, and 5 in 2000) totaling 19 injuries and 1 fatality. The accident resulting in the fatality (occurring in 1998) also accounted for 5 injuries. In Table 8 below is the information concerning alarms on I-90 reported and responded to by Eastside Fire and Rescue during the years 1998 to 1999. The number of alarms include fire and aid related calls since any increase in the traffic volume would also increase the number of that type of call as well.

2.5 PEDESTRIAN AND BICYCLE FACILITIES

2.5.1 Existing Conditions

Sidewalks in the study area are only found along SE 146th Street and part of the east side of 468th Avenue SE between SE 144th Street and SE 146th Street. Pedestrian and bicycles travel currently occurs on the shoulders of 468th Avenue SE. Shoulder width is adequate in some locations and inadequate in others, making pedestrian and bicycle travel hazardous. Provisions for bicycle and pedestrian travel along SE Homestead Valley Road near Olallie State Park is adequate except where shoulders do not exist. Wide, soft shoulders and off-road trails allow pedestrians to travel along most of SE Homestead Valley Road. Due to the low volume of vehicles and bicyclists, bicycle travel along SE Homestead Valley Road is not a major safety concern.

2.5.2 Planned Improvements

No sidewalks or bicycle lanes are programmed within King County Transportation Plans for the proposed project area. Sidewalks may be provided with new development.

2.6 SCHOOL TRANSPORTATION

2.6.1 Existing Conditions

Currently, three bus routes make a combined 11 daily trips on 468th Avenue SE to service students of the Snoqualmie Valley School District. With the construction of the proposed new elementary and middle schools (projected to be completed by 2005), additional buses and routes will be added as necessary. Projections for these two schools were based on average trips made, given the proposed size of the school converted to automobiles and projected to increase at a 2.5% per year growth rate to obtain a worst case scenario of traffic in and around the proposed school area.

2.6.2 Future School Bus/Pedestrian Routes

Information provided by the Snoqualmie Valley School District indicates that prior to the development of bus routes for the proposed schools, a safety analysis must be performed. The School District is bound to bus children that would be required to walk a mile or more to school. An evaluation of existing land use within the study area and within a one-mile radius of the proposed elementary and middle school sites shows two residential areas within that radius. Children living in residences along SE North Bend Way might be required to walk within the project area between SE North Bend Way and SE 146th Street along 468th Avenue SE. The second area within the one-mile radius is south of I-90 along SE 150th Street and SE 153rd Street. A small portion of the community falls within the one-mile radius. Considering the fact that many of the children south of I-90 would require busing and that walking through an interstate interchange area would be required for the other children, it is unlikely that the school district would require any of the children who live south of the interstate to walk to school.

2.7 SNOQUALMIE RIVER BRIDGE

2.7.1 Existing

The existing bridge across the South Fork of the Snoqualmie River located north and east of Exit 38 (East) was built in 1983 for SE Grouse Ridge Road to access the Washington State Patrol Fire Training Academy. The one-lane bridge is 137 feet long and 16 feet wide and appears to be in good shape. This bridge also appears to have had minimal use since 1983. It typically would have a design life of 50 to 75 years. It has a posted weight limit of 36 tons.

At the south end of the bridge the road is straight and flat for 50 feet, including the 25 feet of guardrail bridge-ends on either side. During the next 250 feet south, the road curves 45 degrees left then back before it curves right disappearing into the trees towards the entrance gate and I-90 Exit 38 (East). The road slopes gently south. There is adequate sight distance approaching and leaving the south end of the bridge.

The north end of the bridge is straight for approximately 100 feet, including 70 feet of guardrail bridge-ends on either side. The road raises quickly over the next 200 feet, and then it curves 60 degrees right and then back left as it disappears behind the natural rock (walls) and the trees. Utilities in the vicinity of the bridge include underground fiber-optic cable telephone and power.

2.7.2 Bridge Weight Limits

According to WSDOT, an HS 36 (ton) bridge has an operating capacity 60% greater than the inventory rating (36 tons). This means that this bridge can carry up to the 54-ton trucks proposed for use by this project. The bridge can only accommodate one legal loaded vehicle at a time. The design live load on this bridge is AASHTO rated HS-20-44 according to the engineering plans. Typically, bridges are designed with a factor-of-safety of 1.3 for dead load and 2.7 for live load. It appears that this bridge foundation and pilings meet this criteria.

2.8 I-90 CLOSURES

In the winter, when I-90 is closed for avalanche control near Snoqualmie Pass, the 468th Avenue SE exit (Exit 34) experiences higher than normal traffic volumes. In particular, truck volumes in the area increase because many eastbound trucks pull off the highway to take advantage of the amenities at Seattle East Auto Truck Plaza while they wait for the pass to re-open. During pass closures, local citizens report that 468th Avenue SE becomes practically impassible.

WSDOT Communications Center at Hyak provided I-90 closure data for previous winters. During an average winter, Snoqualmie Pass is closed approximately 40 times (see Table 8). Figure 13 shows the number of closures for the winters of 1995 through 1998 by various durations. The frequency and duration of closures is related to the severity of winter weather. Most of the closures were relatively brief, lasting less than 1 hour. Extended closures occur much less frequently. All of the closures that were longer than 48 hours occurred in early 1997.

TABLE 6
WEATHER-RELATED CLOSURES OF EASTBOUND I-90: 1995 TO 1998

Location of Closure	Number of Closures			Total Duration of Closures (hours)		
Milepost on I-90	1995-96	1996-97	1997-98	1995-96	1996-97	1997-98
MP 38	5	10	4	91	647	16
MP 47 and Eastward	8	26	15	38	716	57
Total Eastbound	13	36	19	125	1363	73

Source: WSDOT Hyak Communications Center.

According to WSDOT, the winter of 1998 to 1999 was the worst on record in western Washington. During this season, the Snoqualmie Pass was closed 55 times. More than 50% of the closures lasted less than one hour. Eighty-five percent of the closures lasted less than three, most of which occurred in the early morning hours.

Due to recent circulation improvements implemented by Seattle East Auto Truck Plaza, the severity of traffic congestion attributable to truck traffic during I-90 closures especially on 468th Avenue SE was significantly reduced this past winter.

2.9 TRAFFIC OPERATION

With the additional truck traffic from this project, the potential would exist for more conflicts and accidents with other vehicles.

2.9.1 Traffic Operation Impact

The gravel mine would be located northeast of the I-90/468th Avenue SE (Edgewick Road) interchanges. Access to this site would occur from an existing roadway (SE 146th Street) that intersects 468th Avenue SE approximately 600 feet north of the I-90 westbound on- and off-ramps at Exit 34.

This traffic analysis was performed using vehicle-classification counts (see Table 4) performed at many locations along 468th Avenue SE, including the ramps to I-90, and at SE North Bend Way in 1998 and 1999. The traffic volumes derived from these counts were used to determine the existing traffic operating conditions in the area, as well as future traffic operations without the project. Project-generated traffic volumes, derived for the concurrent analysis, were used to determine how the proposed mine would affect existing traffic operations. Also evaluated were two potential roadway improvements to determine how each could benefit traffic operations, and when various components of each improvement are needed. This analysis is preliminary, and was performed to help formulate a mitigation strategy for the project.

Pedestrian and bicycle travel along the I-90 exit service streets is potentially hazardous, due to the minimal unpaved shoulders, and minimal ‘shy distance’ available within 11-foot traffic lanes. Background traffic growth combined with the addition of project trucks would make pedestrian and bicycle travel potentially more hazardous, since gaps between opposing traffic volumes would diminish, thereby reducing the flexibility of same-side vehicles to cross the centerline to bypass bikes and pedestrians.

2.9.2 Truck Impacts on Road Maintenance

Heavy trucks have a significant impact on the design and maintenance of road surface and subsurface structures. The major streets serving I-90 interchanges, including I-90, the I-90 ramps, 468th Avenue SE, SE North Bend Way, and SE Homestead Valley Road are truck routes. These streets are classified to support the heavy vehicles. The additional truck weight fees that are paid annually as part of truck licensing support road maintenance for these roads. The haul trucks shown in Figures 9 and 10 would fit well within allowable axle-load allowances: they average 13,000 to 14,000 pounds per axle. Additional permit requirements may also apply to the project haul route operations and loading on existing bridges.

A pavement evaluation of SE Homestead Valley Road, conducted in 2001 shows that pavements are generally inadequate for the anticipated traffic loads of Alternatives 3 and 4. Pavement distress is evident throughout most of the road alignment. The estimated remaining life of the existing pavement is less than about 5 years. Rehabilitation of the roadway could include repair of cracked Portland cement concrete (cc) panels and placement of an asphalt concrete (AC) overlay to meet current King County Standards.

Surface water along the truck routes in the proposed project is currently well managed with drainage ditches and culverts, except for short segments. Ponded water in these areas should be drained away from the road subgrades. The full life expectancy of the pavement sections depends on future roadway maintenance, past and future traffic volumes, and the strength and stiffness of existing subgrades and pavements. Because evaluations of the existing pavements were based on visual observations and a review of construction records, the conclusions and recommendations presented in this report should be considered general in nature pending future in-depth testing.

2.10 AIR QUALITY

Emissions of pollutants from sand and gravel mining come from three types of sources—point sources, area sources, and line sources. The exhaust of stationary equipment such as asphalt or concrete plants are known as “point sources”. Fugitive dust from the working face, aggregate storage piles and processing areas are termed “area sources”. The exhaust stacks of haul trucks and the fugitive dust from truck travel on paved or unpaved roads are called “line sources.” The proposed alternatives would impact transportation use which in turn affects the air quality, which is referenced herein and discussed in detail in the Air Quality Technical Report for this EIS.

3.0 ENVIRONMENTAL IMPACTS

3.1 ALTERNATIVE 1–NO ACTION

3.1.1 Construction Impacts

The No Action alternative would have no construction impacts.

3.1.2 Operational Impacts

Traffic generated under Alternative 1 is built into the existing conditions analysis discussed earlier. The following analysis shows traffic projections for future years with No Action.

Table 9 and Table 10 show the projected AM and PM peak-hour intersection LOS and total movement delays for the No Action Alternative for the three study years (2005, 2015, and 2025).

TABLE 7
NO ACTION AM PEAK-HOUR LEVEL OF SERVICE SUMMARY

Intersection	2005		2005 VISSIM		2015		2025		2025 VISSIM	
	LOS[a]	Delay[b]	LOS[a]	Delay[c]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[c]
SE North Bend Way/436th Ave SE										
NB Left, & Right	E	46.6			F	631.5	F	>1,000		
WB Left, & Through	A	8.1			A	8.4	A	8.8		
I-90 WB Ramps/436th Ave SE										
WB Left & Through	F	138.2			F	956.8	F	>1,000		
WB Right	B	11.8			B	13.4	C	16.2		
NB Left	B	11.6			C	18.2	F	190.2		
I-90 EB Ramps/436th Ave SE										
EB Left & Through	D	32.4			F	82.4	F	420		
EB Right	A	9.2			A	9.6	B	10.1		
SB Left	B	11.1			B	13.1	C	17.1		
Middle Fork Road/468th Avenue SE										
WB Left, & Right	B	15.0			C	23.8	F	197.4		
SB Left, & Through	A	8.0			A	8.2	A	8.7		
SE 146th Street/468th Avenue SE										
EB Left, Through, & Right	B	11.4	A	9.7	B	13.1	C	16.6	B	14.1
WB Left, Through, & Right	C	17.0	C	18.1	C	22.8	E	37.4	E	46.0
NB Left, Through, & Right	A	8.9	A	2.3	A	9.2	A	9.6	A	5.5
SB Left, Through, & Right	A	7.9	A	0.3	A	8.2	A	8.5	A	0.5
SE North Bend Way/468th Ave SE										
EB Left, & Right	B	14.8	C	18.9	C	19.4	D	33.1	F	173.2
NB Left, & Through	A	8.4	A	2.4	A	8.6	A	9.0	B	14.2
I-90 WB Ramps/468th Ave SE										
WB Left, Through, & Right	B	12.0	A	9.9	B	13.5	C	16.3	D	30.4
NB Left, & Through	A	7.9	A	0.7	A	8.1	A	8.4	A	7.2
I-90 EB Ramps/468th Ave SE										
EB Left, Through, & Right	B	13.9	A	7.6	C	18.6	E	40.0	B	10.3
SB Left, & Through	A	8.0	B	12.0	A	8.1	A	8.3	C	19.7

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds calculated by HCS2000.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculation
NB = northbound, WB = westbound, EB = eastbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

TABLE 8
NO ACTION PM PEAK-HOUR LEVEL OF SERVICE SUMMARY

Intersection	2005		2005 VISSIM		2015		2025		2025 VISSIM	
	LOS[a]	Delay[b]	LOS[a]	Delay[c]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[c]
SE North Bend Way/436th Ave SE										
NB Left, & Right	F	637.1			F	>1,000	F	>1,000		
WB Left, & Through	A	8.9			A	9.7	B	10.9		
I-90 WB Ramps/436th Ave SE										
WB Left & Through	F	62.8			F	358.6	F	>1,000		
WB Right	B	12.5			B	14.9	C	19.7		
NB Left	B	10.3			B	12.5	C	19.0		
I-90 EB Ramps/436th Ave SE										
EB Left & Through	F	139.4			F	>1,000	F	>1,000		
EB Right	F	198.8			F	>1,000	F	>1,000		
SB Left	A	8.7			A	9.4	B	10.4		
Middle Fork Road/468th Avenue SE										
WB Left, & Right	B	13.8			C	19.4	F	59.9		
SB Left, & Through	A	8.1			A	8.5	A	9.1		
SE 146th Street/468th Avenue SE										
EB Left, Through, & Right	B	13.5	C	20.1	C	17.3	D	27.9	C	20.3
WB Left, Through, & Right	C	22.6	F	54.7	E	36.0	F	99.6	F	314.2
NB Left, Through, & Right	A	9.9	A	9.4	B	10.7	B	12.1	D	28.3
SB Left, Through, & Right	A	7.8	A	0.5	A	8.0	A	8.2	A	0.9
SE North Bend Way/468th Ave SE										
EB Left, & Right	C	17.7	C	24.7	D	28.4	F	158.1	F	1,061.8
NB Left, & Through	A	8.6	A	9.8	A	9.1	A	9.8	F	66.5
I-90 WB Ramps/468th Ave SE										
WB Left, Through, & Right	B	12.3	B	12.2	B	14.3	C	18.9	F	198.4
NB Left, & Through	A	8.5	A	4.3	A	9.0	A	9.7	F	210.8
I-90 EB Ramps/468th Ave SE										
EB Left, Through, & Right	D	29.0	C	16.3	F	156.9	F	>1,000	F	658.8
SB Left, & Through	A	8.3	B	14.4	A	8.5	A	8.8	C	23.6

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds calculated by HCS2000.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculations
NB = northbound, WB = westbound, EB = eastbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

3.2 ALTERNATIVE 2–PROPOSAL: LOWER AND UPPER SITES MINING - EXIT 34

Development of the Lower Site's processing plant operations and access road/intersection improvements would generate temporary construction traffic. During construction, heavy construction truck traffic would be far less than truck trips estimated above during the site's peak operation. However, construction may involve a number of oversized equipment hauls. These would occur by permit under conditions set by King County.

3.2.1 Construction Impacts

The construction phase of the Lower Site of the North Bend Gravel Mine consists of:

- Removing the overburden from the Lower Site in order to build an earthen berm on the north and south sides of the processing area
- Disposing of unusable woody material ("slash")
- Clearing a route for the aggregate conveyor transversing the western slope of Grouse Ridge
- Excavating the floor of the Lower Site down to the design level and expanding the floor area to accommodate the future aggregate processing concrete and asphalt plants

Construction impacts would be fugitive dust generated by earth-moving and the exhaust emissions of fine particles matter, carbon monoxide and oxides of nitrogen and sulfur from bulldozers and front-end loaders. The emissions and concentrations of fugitive dust from construction activities are analyzed as part of the Air Quality Technical Report (which also includes the excavation and primary processing of up to 700,000 tons per year of aggregate for use as pit-run material).

The moving of machinery and vehicles augments existing wind turbulence along roadways and at working faces causing dust to raise into the air and be transported by the prevailing winds. The processing of the aggregate by crushing, screening, secondary crushing and dropping into stockpiles also results in PM_{10} emissions. Haul trucks would grind and disperse fugitive dust as they move along the paved access road and out onto the public road system. Truck movement is one of the largest sources of fugitive dust from sand and gravel mines.

Development of the Lower Site's processing plant operations and access road/intersection improvements would generate temporary construction traffic. During construction, heavy construction truck traffic would be far less than the truck trips estimated during the site's peak operation. However, construction may involve a number of oversized equipment hauls. These would occur by permit under conditions set by King County.

Construction impacts would be minimal because the Lower Site is already cleared and graded and only minimal additional earth moving would be required. Slight increases in vehicle emissions can be expected from the additional trucks and cars of the construction contractor and from traffic slowing down due to work in construction zones on existing roadways. Traffic along 468th Avenue SE from SE 146th Street to SE North Bend Way could be disrupted at times or even stopped totally if the roadway is widened and improved.

3.2.2 Project Traffic

3.2.2.1 Trip Generation

Trip generation for the Proposal was documented in a memorandum, North Bend Gravel Operation–Trip Generation Information, Heffron Transportation, May 29, 1998 and supplemented in May 1999. This memorandum was prepared to support the Transportation Concurrency Analysis performed by King County.

The trip generation analysis assumed that, initially, the Lower Site off 468th Avenue SE would be used to supply direct sales of unprocessed materials to its customers and other Cadman, Inc. facilities. In the future, as market conditions allow, a concrete batch plant and/or an asphalt batch plant could be built on the Lower Site. At its peak, the site is expected to produce up to 2.1 million tons of gravel, 100,000 cubic yards of concrete, and 150,000 tons of asphalt each year. Maximum production volume during the peak construction month typically represents about 15 percent of the annual production. The site would employ approximately 20 people at full production not counting truck drivers.

The Lower Site Option, which has a smaller operations footprint than the proposed Lower Site development, would not impact the traffic analysis and would perform the same as Alternative 2.

3.2.2.2 Trip Rates

Daily truck-trip generation rates for the proposed project were derived using the average hauling capacity of various types of trucks that are anticipated to serve the site for sand and gravel (aggregate), concrete, and asphalt transport. The trip generation rates assume that two trips are generated for each load of material moved (one trip entering, and one trip exiting). AM and PM peak-hour truck-trip generation rates and employee trip generation rates were derived using 3 days of traffic count data from a similar Cadman, Inc. site in Snohomish County. The counts performed at the Snohomish County site determined that 10.5 percent of the truck trips occur during the AM peak hour, and 1.7 percent of the truck trips occur during the PM peak hour. It was assumed that all of the concrete and asphalt trucks and only a small percentage of the gravel trucks would be stored on the site overnight. Independent contractors own most of the gravel trucks, and would not store their trucks on the site overnight. Truck trips may occur later than the PM peak hour if nighttime construction occurs. However, most construction projects and truck drivers tend to avoid the commuter peak hours, so it is not likely that nighttime activity would increase the site's PM peak-hour traffic.

Diesel trucks, of a variety of sizes, would transport the pit-run, processed aggregate, asphalt, and concrete to end-users. An unpaved onsite road provides access to a sporadically used gravel pit on the Lower Site. This road would be paved to provide access for trucks taking on loads of aggregate and for the mine's employees. Truck traffic is calculated at 359 loads per day of aggregate, 78 loads of concrete, and 30 loads of asphalt under Alternative 2.

Figure 14 shows traffic movement to/from I-90 and SE 146th Street. Vehicles include trucks (aggregates, concrete, and asphalt) and passenger cars. Table 11 shows the number and type of vehicles as well as their direction (inbound or outbound from the site) that would be generated by the Proposal for an average day during the peak of the construction season. The calculation assumes that 15 percent of the annual production would occur during the peak month, with 24 production days during that month. An average day during the peak month represents approximately 0.6 percent of the annual production. Four intersections along 468th Avenue SE would experience slightly higher delays by the addition of project-generated vehicles.

TABLE 9
ALTERNATIVE 2 PROJECT TRIP GENERATION (PROPOSAL)

	Daily Trips (One-way)	AM Peak Hour Trips			PM Peak Hour Trips		
		In	Out	Total	In	Out	Total
Aggregate for Resupply	568	24	36	60	6	4	10
Aggregate for Delivery	152	6	10	16	2	1	3
Aggregate for Batch Plants[a]	0	0	0	0	0	0	0
Concrete	156	0	16	16	3	0	3
Asphalt	60	0	6	6	1	0	1
Total Truck Trips	936	30	68	98	12	5	17
Passenger Vehicle Trips	62	4	1	5	1	7	8
Total Trips	998	34	69	103	13	12	25

[a] Conveyor delivers aggregate for batch plants from top of Grouse Ridge.

Table 11 shows that the Proposal would generate 998 trips per day during the peak month. No truck trips are included for delivery of aggregate for use in batch plants as this would be delivered by conveyor from the upper site to the lower site. Trip generation is not included for Alternative 2A, as this would generate fewer total trips. During the PM peak hour, the site would generate 25 trips during the peak month, or approximately one trip every 2 minutes

3.2.2.3 Trip Distribution Pattern and Assignment

Project-generated trips would arrive and leave the project site via I-90 to Exit 34 (468th Avenue SE) to SE 146th Street. All project-generated trips would use this route, with the exception of some employee trips and those supplying occasional local projects. This is the most direct and safest route and would keep heavy trucks off local streets. The trucks would be directed not to use SE North Bend Way and, by using I-90, could not bypass the weight station.

The Proposal would result in vehicle trips to/from the site by an estimated 20 site-based employees on an average weekday. The site would operate between 5:30 a.m. and 10:30 p.m. Estimates that average weekday site-based employee trips would range from 60 to 65.

As noted in the Methodology section, the likely used haul trucks would have up to nearly twice as many axles and passenger-car equivalents as the average (default) truck assumed by standard LOS calculation software. To conservatively account for these large vehicles in the traffic impact evaluations for street intersections, the number of project truck trips was doubled as input to the LOS calculations.

3.2.2.4 Future-with-Project Volumes

Traffic volumes generated by the proposed gravel mine were added to the future (year 2005) traffic volumes to show how traffic volumes would fluctuate by time of day. Figure 15 shows the volumes by hour and by type of vehicle. Future-with-project volumes for Alternative 2 can be derived for all three study years by adding the project-generated volumes (see Figure 14) to the Alternative 1 (No Action) forecasted volumes (see Figures 6 through 8).

3.2.3 Level of Service

Projected AM and PM peak-hour LOS and delays under Alternative 2 are shown in Table 12 and Table 13, respectively. Table 14 and Table 15 compare the LOS between Alternative 1 (No Action), and Alternative 2 Proposal). Alternative 2 would not impact I-90 Exit 32.

A VISSIM analysis of traffic delay and queuing under Alternative 2 was developed (see Attachment A) for both the AM and PM peak hours for the projected years of 2005, 2015, and 2025. The VISSIM delay is shown in Tables 12 and 13 below.

TABLE 10
ALTERNATIVE 2 AM PEAK-HOUR LEVEL OF SERVICE SUMMARY

Intersection	2005		2005 VISSIM		2015		2025		2025 VISSIM	
	LOS[a]	Delay[b]	LOS[a]	Delay[C]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[C]
SE 146th Street/468th Avenue SE										
EB Left, Through, & Right	B	11.5	B	11.6	B	13.3	C	17.0	C	20.0
WB Left, Through, & Right	E	35.1	F	886.5	F	77.4	F	550.1	F	1,524.7
NB Left, Through, & Right	A	8.9	A	3.0	A	9.2	A	9.6	A	6.6
SB Left, Through, & Right	A	8.0	A	0.7	A	8.3	A	8.6	A	0.9
SE North Bend Way/468th Ave SE										
EB Left, & Right	C	16.8	C	19.4	C	23.0	E	45.8	F	204.3
NB Left, & Through	A	8.6	A	3.2	A	8.9	A	9.3	C	15.1
I-90 WB Ramps/468th Ave SE										
WB Left, Through, & Right	B	12.5	B	10.5	B	14.1	C	17.4	E	45.0
NB Left, & Through	A	8.1	A	1.6	A	8.3	A	8.6	B	13.8
I-90 EB Ramps/468th Ave SE										
EB Left, Through, & Right	C	15.5	A	7.6	C	22.0	F	67.0	B	12.9
SB Left, & Through	A	8.0	B	12.8	A	8.1	A	8.3	C	23.4

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds calculated by HCS2000.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculations
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

TABLE 11
ALTERNATIVE 2 PM PEAK-HOUR LEVEL OF SERVICE SUMMARY

Intersection	2005		2005 VISSIM		2015		2025		2025 VISSIM	
	LOS[a]	Delay[b]	LOS[a]	Delay[C]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[C]
SE 146th Street/468th Avenue SE										
EB Left, Through, & Right	**B**	**13.6**	**C**	**18.1**	**C**	**17.4**	**D**	**28.2**	**D**	**27.3**
WB Left, Through, & Right	**D**	**26.9**	**F**	**148.8**	**E**	**48.2**	**F**	**204.3**	**F**	**806.4**
NB Left, Through, & Right	**A**	**9.9**	**A**	**8.9**	**B**	**10.7**	**B**	**12.1**	**D**	**27.5**
SB Left, Through, & Right	**A**	**7.8**	**A**	**0.5**	**A**	**8.0**	**A**	**8.3**	**A**	**0.7**
SE North Bend Way/468th Ave SE										
EB Left, & Right	**C**	**18.2**	**D**	**29.9**	**D**	**30.1**	**F**	**193.5**	**F**	**816.7**
NB Left, & Through	**A**	**8.6**	**B**	**10.1**	**A**	**9.1**	**A**	**9.9**	**F**	**57.2**
I-90 WB Ramps/468th Ave SE										
WB Left, Through, & Right	**B**	**12.5**	**B**	**13.3**	**B**	**14.6**	**C**	**19.4**	**F**	**130.5**
NB Left, & Through	**A**	**8.5**	**A**	**3.9**	**A**	**9.0**	**A**	**9.8**	**F**	**195.5**
I-90 EB Ramps/468th Ave SE										
EB Left, Through, & Right	**D**	**32.4**	**C**	**16.3**	**F**	**214.6**	**F**	**>1,000**	**F**	**643.8**
SB Left, & Through	**A**	**8.3**	**C**	**15.4**	**A**	**8.5**	**A**	**8.8**	**D**	**28.7**

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds calculated by HCS2000.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculations
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

TABLE 12
ALTERNATIVE 2 AM PEAK-HOUR LEVEL OF SERVICE COMPARISON

Intersection	Existing	2005		2015		2025	
		Alt. 1	Alt. 2	Alt. 1	Alt. 2	Alt. 1	Alt. 2
SE 146th Street/468th Avenue SE							
EB Left, Through, & Right	A	B	B	B	B	C	C
WB Left, Through, & Right	B	C	E	C	F	E	F
NB Left, Through, & Right	A	A	A	A	A	A	A
SB Left, Through, & Right	A	A	A	A	A	A	A
SE North Bend Way/468th Ave SE							
EB Left, & Right	B	B	C	C	C	D	E
NB Left, & Through	A	A	A	A	A	A	A
I-90 WB Ramps/468th Ave SE							
WB Left, Through, & Right	A	B	B	B	B	C	C
NB Left, & Through	A	A	A	A	A	A	A
I-90 EB Ramps/468th Ave SE							
EB Left, Through, & Right	B	B	C	C	C	E	F
SB Left, & Through	A	A	A	A	A	A	A

Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.
EB = eastbound, WB = westbound, NB = northbound, SB = southbound

TABLE 13
ALTERNATIVE 2 PM PEAK-HOUR LEVEL OF SERVICE COMPARISON

Intersection	Existing	2005		2015		2025	
		Alt. 1	Alt. 2	Alt. 1	Alt. 2	Alt. 1	Alt. 2
SE 146th Street/468th Avenue SE							
EB Left, Through, & Right	B	B	B	C	C	D	D
WB Left, Through, & Right	B	C	D	E	E	F	F
NB Left, Through, & Right	A	A	A	B	B	B	B
SB Left, Through, & Right	A	A	A	A	A	A	A
SE North Bend Way/468th Ave SE							
EB Left, & Right	B	C	C	D	D	F	F
NB Left, & Through	A	A	A	A	A	A	A
I-90 WB Ramps/468th Ave SE							
WB Left, Through, & Right	B	B	B	B	B	C	C
NB Left, & Through	A	A	A	A	A	A	A
I-90 EB Ramps/468th Ave SE							
EB Left, Through, & Right	C	D	D	F	F	F	F
SB Left, & Through	A	A	A	A	A	A	A

Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.
EB = eastbound, WB = westbound, NB = northbound, SB = southbound

All movements at the intersections along 468th Avenue SE (Exit 34) are expected to operate at a LOS D or better under Alternative 2 for the AM peak hour, with three exceptions. The westbound left/through/right movement at SE 146th Street is projected to operate at LOS E by 2005 and LOS F by 2015, the eastbound left/right movement at SE North Bend Way is projected to operate at LOS E in 2025, and the eastbound left/through/right movement at the I-90 eastbound ramps is projected to operate at LOS F in 2025.

Under Alternative 2, 468th Avenue SE (Exit 34) would begin to reach capacity by 2005 during the PM peak hour. At the I-90 eastbound ramps, the eastbound left/through/right movement from the I-90 off-ramp to 468th Avenue SE would operate at LOS D by 2005 and LOS F by 2015. At SE 146th Street, the westbound left/through/right movement would begin to approach capacity by 2005 and operate at LOS E by 2015. By 2025, this movement would operate at LOS F. The eastbound left/ right movement at SE North Bend Way is expected to operate at LOS D by 2015 and LOS F by year 2025.

The greatest impact from Alternative 2 during the AM peak hour would be the westbound left/through/right movement from the Lower Site at the intersection of SE 146th Street/468th Avenue SE. The approach would operate at LOS C under Alternative 1 in 2015 and LOS E under Alternative 2. In 2025, this movement is expected to operate at LOS E under Alternative 1 and is expected to operate at LOS F by 2025 under Alternative 2.

During the PM peak hour along 468th Avenue SE, the intersections at SE 146th Street, SE North Bend Way, and the I-90 eastbound ramps will all have movements that operate at LOS F with or without the Proposal in 2025. The additional traffic generated by the project would exacerbate the poor LOS because the addition of a few trucks on an over-capacity movement has a greater impact than that on an under capacity movement.

Queuing of project vehicles due to delays at the site, if any, can be accommodated on-site. Significantly more queuing space is available at the project site than on the approach roadways.

3.2.4 Traffic Safety

Additional truck traffic from the proposed project under Alternative 2, especially on 468th Avenue SE, would cause more conflicts or potential conflicts with other vehicles, pedestrians, bicycles, and school buses. The conflict areas of greatest safety concern are the right-turn movements into the Lower Site from 468th Avenue SE to SE 146th Street and the left turns from SE 146th Street onto 468th Avenue SE heading south to I-90. There are also concerns about additional vehicular traffic at the I-90 eastbound ramps and 468th Avenue SE intersection. This intersection would reach capacity by 2015 for the PM peak hour. Another area of concern is along 468th Avenue SE south of SE 146th Street to I-90, where truck traffic is not separated from pedestrians or bicyclists using the shoulder.

3.2.5 Pedestrian and Bicycle Travel

Although the Proposal is not projected to increase pedestrian or bicycle traffic, truck traffic along SE 146th Street and 468th Avenue SE would cross pedestrian and bicycle routes. Additional development along 468th Avenue SE and completion of two schools in the area would likely increase pedestrian and bicycle use.

3.2.6 School Transportation

Planned completion of both an elementary and middle school during the life of this project at the north end of 468th Avenue SE and SE Middle Fork Road would increase school related bus, car, pedestrian and bicycle traffic in the project area. Additional truck traffic from the Proposal would conflict with school traffic traveling on 468th Avenue SE, turning at SE North Bend Way, and using the I-90 on/off ramps starting at 2005.

3.2.7 Weight Limits

The total full truck weight could be up to 54 tons (almost the legal highway load limit for full trucks) leaving the gravel operation facility at SE 146th Street. Most large buses (including school buses) meet or exceed the legal load limit for roadways. This means all roadways carrying the project truck and/or school bus operations must be capable of carrying the state highway capacity legal weight load. Heavy truck traffic would shorten the life of road infrastructure, even that designed to carry heavy weights. This is especially true for bridges like the one on SE Grouse Ridge Road, over the South Fork of the Snoqualmie River. There will be increased deterioration of the bridge superstructure (girders and roadway deck), which will need to be monitored.

3.2.8 I-90 Closures

When I-90 closes due to snowfall in Snoqualmie Pass or an accident, some of the eastbound truck traffic waits for reopening near or at the Seattle East Auto Truck Plaza on 468th Avenue SE across from the Lower Site entrance. During these times, project-related traffic could conflict with additional non-project heavy truck traffic, especially along 468th Avenue SE North Bend Way.

3.2.9 Public Services

The police, fire and emergency services under this alternative would experience more conflicting traffic on 468th Avenue SE and at Exit 34. The non-emergency police and fire traffic traveling to the Washington State Patrol Fire Training Academy on SE Grouse Ridge Road would experience a multiple increase in conflicting traffic on the one-lane roadway, though total traffic would still be less than 1,000 vehicles per day.

3.2.9.1 Alternative 2–Upper Site Mining and Limited Lower Site Mining - Exit 34

Project impacts would be the same as described under Alternative 2.

3.3 ALTERNATIVE 3–LOWER AND UPPER SITES MINING (EXITS 34 AND 38)

3.3.1 Construction Impacts

Construction impacts in the area of the project Lower Site, including along 468th Avenue SE, under Alternative 3 would be similar to those listed under Alternative 2. When the access road is improved the current traffic to and from the Washington State Patrol Fire Training Academy could be disrupted at times or even stopped totally. It is likely that the roadway would be temporarily closed for part of the time. Also, construction trucks and equipment would use SE Homestead Valley Road to access this site.

3.3.2 Project Traffic

3.3.2.1 Trip Generation

Trip generation under Alternative 3 was prepared by Heffron Transportation using the same assumptions as for Alternative 2. The only difference in trip generation between Alternative 3 and Alternative 2 would be additional haul truck trips transporting aggregate from the Upper to the Lower Site because the conveyor would not be built. All aggregate trucks would originate from the Upper Site, and all asphalt or concrete trucks would originate from the Lower Site. This would result in one gravel load generating four truck trips but only two trucks, two full and two empty – two using 468th Avenue SE (Exit 34) and two using SE Homestead Valley Road (Exit 38).

The Lower Site Option, which has a smaller operational footprint than the proposed Lower Site development, would not impact the traffic analysis and would perform the same as Alternative 3.

3.3.2.2 Trip Rates

Daily truck trip generation rates for the proposed project were derived using the same methodology described for Alternative 2 (see section 3.2.2.3 and Table 8)

Figure 16 shows the Alternative 3 traffic movement to/from I-90 and SE 146th Street. Vehicles include trucks (aggregate, concrete, and asphalt) and passenger cars. Table 16 shows the number and type of vehicles as well as their direction (inbound or outbound from the site) that would be generated by Alternative 3 for an average day during the peak construction month. Assumptions regarding production are the same as for Alternative 2. Only the four intersections along 468th Avenue SE would experience slightly higher delays by the addition of project vehicles.

3.3.2.3 Peak Season Trip Generation

Figure 15 shows the Alternative 3 project-generated vehicles traveling to/from I-90 and SE 146th Street. Vehicles include trucks (aggregates, concrete, and asphalt) and passenger cars. Table 16, prepared by Heffron Transportation, shows the number and type of vehicles as well as their direction (inbound or outbound from the site) generated by the project for an average day during the peak construction month.

This condition assumes that 15% of the annual production occurs during the peak month, and that there are 24 production days (Monday through Saturday) during that month. An average day during the peak month represents approximately 0.6% of the annual production. The project-generated vehicles for Alternative 3 were added to the No Action Alternative volumes and analyzed using HCS. Only the four intersections located along 468th Avenue SE would experience slightly higher delays by the addition of the project vehicles.

TABLE 14
PROJECT TRIP GENERATION (ALTERNATIVE 3)

	Daily Trips	AM Peak Hour Trips			PM Peak Hour Trips		
	(One-way)	In	Out	Total	In	Out	Total
Aggregate for Resupply[1]	568	24	36	60	6	4	10
Aggregate for Delivery[1]	152	6	10	16	2	1	3
Aggregate for Batch Plants[2]	118	6	6	12	1	1	2
Concrete	156	0	16	16	3	0	3
Asphalt	60	0	6	6	1	0	1
Total Truck Trips	1,054	36	74	110	13	6	19
Passenger Vehicle Trips	62	4	1	5	1	7	8
Total Trips	**1,116**	**40**	**75**	**115**	**14**	**13**	**27**

1 Aggregate for resupply and Delivery is trucked from top of Grouse Ridge at the Upper Site.
2 Aggregate for batch plants is trucked from top of Grouse Ridge at the Upper Site to the Lower Site.

The above trip generation table shows that Alternative 3 would generate 1,116 trips per day during the peak month. Total truck trips are higher in Alternative 3 than in the Proposed Alternative (Alternative 2) due to the aggregate for batch plants being trucked from the upper site to the lower site. Trip generation was not completed for Alternative 3A as this would generate fewer total trips. During the PM peak hour, the site would generate 27 trips.

3.3.2.4 Trip Distribution Pattern and Assignment

Gravel extracted from the Lower Site (Edgewick) would be transported from the site via SE 146th Street, 468th Avenue SE, and Exit 34, with the exception of product supplying local projects. After extraction has been completed in the Lower Site, the Upper Site (Grouse Ridge) would be developed, and material hauled out using SE Grouse Ridge Road via I-90 at Exit 38. Aggregate processing would take place on the Upper

Site would also be hauled via Exit 38. The concrete and asphalt batch plants would be located at the Lower Site, and product generated in those plants would also be hauled via Exit 38.

3.3.2.5 Future-with-Project Volumes

Future forecasted traffic volumes under Alternative 3 were derived by adding project-generated volumes (see Figure 16) to the No Action forecasted volumes (see Figures 6 through 8). The additional truck traffic on SE Grouse Ridge Road would increase to as high as two vehicles passing each other every minute during the peak hour.

3.3.3 Level of Service

Projected AM and PM peak hour LOS and delays under Alternative 3 are presented in Table 16 and Table 17, respectively. Table 18 and Table 19 gives a comparison of the levels of service between the No Action Alternative versus Alternative 3.

TABLE 15
ALTERNATIVE 3–AM PEAK HOUR LEVEL OF SERVICE SUMMARY

Intersection	Year 2005		Year 2015		Year 2025	
	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[b]
SE 146th Street/468th Avenue SE						
EB Left, Thru, & Right	B	11.4	B	13.2	C	16.6
WB Left, Thru, & Right	C	24.4	E	38.2	F	87.2
NB Left	A	8.8	A	9.2	A	9.5
SB Left	A	8.0	A	8.3	A	8.6
SE North Bend Wy/468th Ave SE						
EB Left, & Right	C	15.8	C	19.7	D	32.8
NB Left	A	8.6	A	8.7	A	9.0
I-90 WB Ramps/468th Ave SE						
WB Left, Thru, & Right	B	11.9	B	13.3	C	16.2
NB Left	A	8.0	A	8.2	A	8.5
I-90 EB Ramps/468th Ave SE						
EB Left, Thru, & Right	B	14.0	C	18.9	E	40.7
SB Left	A	7.9	A	8.0	A	8.2

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds calculated by HCS2000.
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

TABLE 16
ALTERNATIVE 3–PM PEAK HOUR LEVEL OF SERVICE SUMMARY

Intersection	Year 2005		Year 2015		Year 2025	
	LOS[1]	Delay[2]	LOS	Delay	LOS	Delay
SE 146th Street/468th Avenue SE						
EB Left, Thru, & Right	B	13.3	C	17.4	D	27.7
WB Left, Thru, & Right	C	23.4	E	41.6	F	141.7
NB Left	A	9.6	B	10.7	B	11.8
SB Left	A	8.0	A	8.0	A	8.2
SE North Bend Way/468th Ave SE						
EB Left, & Right	C	18.0	D	29.3	F	174.7
NB Left	A	8.6	A	9.1	A	9.8
I-90 WB Ramps/468th Ave SE						
WB Left, Thru, & Right	B	12.3	B	14.3	C	18.7
NB Left	A	8.5	A	9.0	A	9.8
I-90 EB Ramps/468th Ave SE						
EB Left, Thru, & Right	D	29.8	F	177.8	F	>1,000
SB Left	A	8.2	A	8.4	A	8.6

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds calculated by HCS2000.
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

TABLE 17
ALTERNATIVE 3–AM PEAK HOUR LEVEL OF SERVICE COMPARISON

Intersection	Existing	Year 2005		Year 2015		Year 2025	
		Alt. 1	Alt. 3	Alt. 1	Alt. 3	Alt. 1	Alt. 3
SE 146th Street/468th Avenue SE							
EB Left, Thru, & Right	A	B	B	B	B	C	C
WB Left, Thru, & Right	B	C	C	C	E	E	F
NB Left	A	A	A	A	A	A	A
SB Left	A	A	A	A	A	A	A
SE North Bend Wy/468th Ave SE							
EB Left, & Right	B	B	C	C	C	D	D
NB Left	A	A	A	A	A	A	A
I-90 WB Ramps/468th Ave SE							
WB Left, Thru, & Right	A	B	B	B	B	C	C
NB Left	A	A	A	A	A	A	A
I-90 EB Ramps/468th Ave SE							
EB Left, Thru, & Right	B	B	B	C	C	E	E
SB Left	A	A	A	A	A	A	A

EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

TABLE 18
ALTERNATIVE 3–PM PEAK HOUR LEVEL OF SERVICE COMPARISON

Intersection	Existing	Year 2005		Year 2015		Year 2025	
		Alt. 1	Alt. 3	Alt. 1	Alt. 3	Alt. 1	Alt. 3
SE 146th Street/468th Avenue SE							
EB Left, Thru, & Right	B	B	B	C	C	D	D
WB Left, Thru, & Right	B	C	C	E	E	F	F
NB Left	A	A	A	B	B	B	B
SB Left	A	A	A	A	A	A	A
SE North Bend Wy/468th Ave SE							
EB Left, & Right	B	C	C	D	D	F	F
NB Left	A	A	A	A	A	A	A
I-90 WB Ramps/468th Ave SE							
WB Left, Thru, & Right	B	B	B	B	B	C	C
NB Left	A	A	A	A	A	A	A
I-90 EB Ramps/468th Ave SE							
EB Left, Thru, & Right	C	D	D	F	F	F	F
SB Left	A	A	A	A	A	A	A

EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only Critical Movements shown. Those movements with free-flow through intersection are not represented here.

All movements at intersections along 468th Avenue SE (Exit 34) would continue to operate at LOS C or better under Alternative 3 for the AM peak hour, with the exception of the westbound left/through/right movement at SE 146th Street. This movement would operate at LOS D in 2015 and LOS E in 2025. All four Exit 38 ramp intersections are underutilized and would not experience additional adverse delays due to the proposed project in either the AM or PM peak hour.

As indicated on Table 14-17, intersections at 468th Avenue SE under Alternative 3 would begin to reach capacity during the PM peak hour by 2015. The eastbound left/through/right movement at the I-90 eastbound ramps (Exit 34) are projected to operate at LOS F by 2015. The westbound left/through/right movement at SE 146th Street is projected to approach capacity by 2015 and operate at LOS E, and then operate at LOS F by 2025. The eastbound left/right movement at SE North Bend Way is expected to operate at LOS F by 2025. All four I-90 Exit 38 ramp intersections at SE Homestead Valley Road are underutilized and would not experience additional adverse delays due to the proposed project.

The greatest impact during the AM peak hour from Alternative 3 traffic would be at the westbound approach to the intersection of SE 146th Street with 468th Avenue SE during year 2015. The approach would operate at LOS F under Alternative 3, compared with LOS C under the No Action Alternative 1. In 2025, this movement (westbound at 468th Avenue SE/146th Avenue SE) degrades to LOS E in Alternative 1 and remains at LOS F (with more congestion) in Alternative 3. Additionally, in 2025, the eastbound movements of SE North Bend Way degrade from a LOS D in Alternative 1 to LOS E in Alternative 3. Further, in 2025, the eastbound movements at I-90 Eastbound ramps and 468th Avenue SE degrade from LOS E in Alternative 1 to LOS F in Alternative 3.

The greatest impact during the PM peak hour from Alternative 3 traffic would be at the eastbound approach to the intersection of the eastbound I-90 ramps with 468th Avenue SE during the study year 2015 and 2025. The approach at the off-ramp would operate at LOS F under Alternative 3 (the same as Alternative 1). Additionally, the westbound movements at SE 146th Street and 468th Avenue SE in 2015 are projected to operate at LOS E under both Alternatives 1 and 3. Further, traffic at intersections along 468th Avenue SE at SE 146th Street and SE North Bend Way would also operate at LOS F by 2025 under both Alternatives 1 and 3. Additional trucks at these intersections under Alternative 3 would increase the severity of the poor LOS.

Queuing of project vehicles due to delays at the site, if any, can be accommodated on-site. Significantly more queuing space is available at the project site than on the approach roadways.

3.3.4 Traffic Safety

When the Lower Site is mined, traffic safety impacts on 468th Avenue SE would be similar to those resulting from Alternative 2.

Traffic safety impacts for the Upper Site and SE Grouse Ridge Road would include passing roadway traffic, potential bottlenecks at the one-lane bridge, steep slopes off the sides of the roadway, tight roadway turns, and limited sight distance. There also would be additional truck traffic on SE Homestead Valley Road, which has two narrow bridges and leads to the entrance to Olallie State Park. Truck traffic in and out of the Upper Site would conflict with pedestrian and bicycle traffic on SE Homestead Valley Road. Additional conflicts with pedestrian and bicycle recreation traffic could occur along SE Homestead Valley Road, especially during summer when Olallie State Park is at maximum use and the demand for construction material would be high.

3.3.5 Pedestrian and Bicycle Travel

Although Alternative 3 is not projected to increase pedestrian and bicycle traffic, truck traffic in and out of the Lower Site during operation would conflict with pedestrian and bicycle traffic along SE 146th Street and 468th Avenue SE. Additional pedestrian and bicycle travel along 468th Avenue SE would likely increase as the proposed elementary school and middle school open (projected for 2005 for this traffic analysis). Truck traffic in and out of the Upper Site will conflict with pedestrian and bicycle traffic on SE Homestead Valley Road, especially near the entrance to Olallie State Park.

3.3.6 School Transportation

Impacts would be similar to those from Alternative 2 along 468th Avenue SE. Traffic from the Upper Site also may conflict with school bus traffic on SE Homestead Valley Road.

3.3.7 Weight Limits

Total truck weights could be up to 54 tons (almost the legal highway load limit for full trucks) leaving the Lower Site at SE 146th Street. Heavy truck traffic will shorten the life of all infrastructures; this is especially true for bridges such as the SE Grouse Ridge Road, over the South Fork of the Snoqualmie River. The bridge superstructure (girders and roadway deck), would need to be monitored for increased deterioration. Only one loaded truck would be able to cross the bridge at a time in order to stay under weight limits.

3.3.8 I-90 Closures

Impacts would be similar to those described for Alternative 2 along 468th Avenue SE. In addition, the closure of I-90 could cause extreme overflow conditions, and trucks also could be directed to the military's convoy staging locations along SE Homestead Valley Road because Exit 38 would have to remain open for the proposed project operation. Conflicts with gravel trucks accessing the Upper Site via Exit 38 and SE Homestead Valley Road could occur. Though Exit 38 and SE Homestead Valley Road would likely remain open during I-90 closures and be useable for gravel trucks accessing the Upper Site, traffic would likely slow due to congestion and snow/ice conditions.

3.3.9 Public Services

The police, fire and emergency services under this alternative would experience more conflicting traffic on 468th Avenue SE and at Exit 34. They would also experience more conflicting traffic along Homestead Valley Road and at the Exit 38 interchanges. The non-emergency police and fire traffic traveling to the Washington State Patrol Fire Training Academy on SE Grouse Ridge Road would experience a multiple increase in conflicting traffic on the one-lane roadway, though total traffic would still be less than 1,000 vehicles per day.

3.3.10 ALTERNATIVE 3A–UPPER SITE MINING AND LIMITED LOWER SITE MINING - EXITS 34 AND 38

Project impacts would be the same as described under Alternative 3.

3.4 ALTERNATIVE 4–UPPER SITE MINING - EXIT 38

3.4.1 Construction Impacts

Construction impacts in the area of the Upper Site, including along SE Homestead Valley Road, under Alternative 4 would be similar to those listed under Alternative 3 for the site and road. During construction, when the Upper Site access road (SE Grouse Ridge Road) is widen and realigned, the current traffic to and from Washington State Patrol Fire Training Academy could be disrupted, and it is likely some of the time the roadway would be temporarily closed. Also construction trucks and equipment would be using SE Homestead Valley Road and SE Grouse Ridge Road to get access the site.

3.4.2 Project Traffic

3.4.2.1 Trip Generation

Trip generation for the Alternative 4, prepared by Heffron Transportation assumes that, initially, the Upper Site would be used to supply direct sales of unprocessed materials to its customers and other Cadman, Inc. facilities. The Lower Site would not be excavated or developed. At its peak, the site is expected to produce up to 2.1 million tons of gravel. The site would employ approximately 17 people at full production.

Fewer trips would be generated under Alternative 4 than Alternatives 2 or 3 because it would not include the asphalt or concrete batch plants. All truck traffic would originate from the Upper Site. Because aggregate would not be used for asphalt or concrete production, more aggregate would be trucked off site.

3.4.2.2 Peak Season Trip Generation

Alternative 4 project-generated vehicles traveling to/from I-90 would be using Exit 38 only. Minimal to no adverse traffic impacts at Exit 38 would occur at the ramp intersections. Table 19, prepared by Heffron Transportation, shows the number and type of vehicles as well as their direction (inbound or outbound from the site) generated by the project for an average day during the peak construction month.

TABLE 19
PROJECT TRIP GENERATION (ALTERNATIVE 4)

	Daily Trips	AM Peak Hour Trips			PM Peak Hour Trips		
	(One-way)	In	Out	Total	In	Out	Total
Aggregate for Resupply	568	24	36	60	6	4	10
Aggregate for Delivery	318	13	20	33	3	2	5
Aggregate for Batch Plants*	0	0	0	0	0	0	0
Concrete	0	0	0	0	0	0	0
Asphalt	0	0	0	0	0	0	0
Total Truck Trips	886	37	56	93	9	6	15
Passenger Vehicle Trips	52	3	1	4	1	6	7
Total Trips	**938**	**40**	**57**	**97**	**10**	**12**	**22**

*Aggregate for batch plants would be trucked to Redmond or Issaquah.

The above trip generations show that the project Alternative 4 would generate 938 trips per day during the peak month. During the PM peak hour, the site would generate 22 trips.

3.4.2.3 Trip Distribution Pattern and Assignment

Under Alternative 4, extraction and aggregate processing would occur at the Upper Site only, with processed material hauled out via SE Grouse Ridge Road and Homestead Valley Road to Exit 38. Onsite concrete and asphalt batch plants are not to be included in this alternative.

3.4.2.4 Future-with-Project Volumes

All four Exit 38 ramp intersections are underutilized and would not experience adverse delays or change in level of service due to the project. The additional truck traffic on SE Grouse Ridge Road and Homestead Valley Road would increase to as high as two vehicles passing each other every minute during the peak hour.

3.4.3 Level of Service

All four I-90 ramp intersections at Exit 38 would continue to operate at a LOS A in the year 2025. Alternative 4 would no impact Exit 32 or Exit 34. These two exits would operate the same as under Alternative 1. The major LOS impact would be to SE Grouse Ridge Road and its bridge over the South Fork of the Snoqualmie River.

3.4.4 Traffic Safety

Under Alternative 4, all safety concerns would be similar to Alternative 3, but traffic impacts would be more intense and felt sooner. SE Grouse Ridge Road is a one-lane, 14-foot wide, 2.5-mile road with some turnouts that would become the principal access to the Upper Site. Truck traffic from the proposed project would be passing by and conflicting Fire Training Academy traffic. There would be a potential for bottlenecks and collisions where two vehicles meet, especially where there are roadway sight distance problems. If traffic leaves the roadway to allow other traffic to pass, the steep slopes and trees off the road side, drainage swales, and limited sight distance would hamper safe vehicle return to the roadway. The one-lane bridge across the South Fork of the Snoqualmie River would be another safety concern. Safety issues on SE Homestead Valley Road would be similar to those discussed for Alternative 3.

3.4.5 Pedestrian and Bicycle Travel

Although Alternative 4 project is not projected to increase pedestrian and bicycle traffic, truck traffic in and out of the Upper Site would conflict with pedestrian and bicycle traffic on SE Homestead Valley Road. Impacts would be similar although likely greater than, those for Alternative 3 along SE Homestead Valley Road because this route would be used for the duration of the project.

3.4.6 School Transportation

Truck traffic from mining, at the Upper Site would likely conflict with the school traffic generated from the future schools off 468th Avenue SE and existing district schools in the city of North Bend. School traffic would travel on SE Homestead Valley Road and onto I-90 Exits 38 and 34 on/off ramps.

3.4.7 Weight Limits

Impacts of heavy trucks would be similar to those described for Alternative 3.

3.4.8 I-90 Closures

Impacts would be similar to those described for Alternative 3.

3.4.9 Public Services

The non-emergency police and fire traffic traveling to the Washington State Patrol Fire Training Academy on SE Grouse Ridge Road would experience a multiple increase in conflicting traffic on the one-lane roadway, though total traffic would still be less than 1,000 vehicles per day.

3.5 SECONDARY AND CUMULATIVE IMPACTS

Secondary or cumulative transportation impacts from the proposed development should be viewed in terms of localized and regional growth in traffic. At least three of the four project alternatives would likely accelerate the need to improve 468th Avenue SE from I-90 Exit 34 to SE 140th Street. Those improvements are discussed later in this section.

3.5.1 Current/Proposed Associated Operational Policies and Procedures

3.5.1.1 Truck Drivers Orientation

All truck drivers serving the project site would need to be aware of the potential hazards of driving through the school zone, along the major streets, in east North Bend. Such measures as slowing to 10-15 mph during school peak periods (7:15 to 7:45 a.m. and 2:15 to 2:45 p.m.), and stopping for the outbound school bus “platoon” during peak periods, would enhance the safety of vehicular and pedestrian travel in the vicinity of the school. Truck driver orientation would be similar to a formalized “Driver Mentor Program”.

3.5.1.2 Special Washing Procedures

A special pressurized washing area should be constructed onsite to clean hauling trucks and wheels prior to leaving the project site to minimize air pollution and the spilling of rocks and dust particles on area roadways. This should also help to alleviate windshield damage to vehicles within the project area

3.5.2 Impacts of Off-Site Traffic Noise

The North Bend area adjacent to the Lower Site is currently subject to noise from a variety of sources with traffic noises being predominant. Noise from the long westbound descent of I-5 into North Bend was noticeable at all of the measurement sites. Local truck and passenger car traffic was noticeable at (monitored) Site 2 (WoodRiver subdivision) and Site 4 (future middle school site).

Motor vehicle traffic traveling on public roads is exempt from noise regulation, but King County and the Department of Ecology have motor vehicle performance standards setting the maximum noise level from individual vehicles (and not applicable to general traffic noise) measured under specific testing criteria.

Although exempt from regulation under the King County Noise Ordinance, the noise impacts of project-generated traffic on public roads was examined using the FHWA model Stamina/Optima. Project traffic causes slight increases in noise levels at SLM sites 1 and 8 ranging from 0.5 to 2.8 dBA for the Proposal. Alternative 3 would have very similar effects, Alternative 4 does not use Exit 34 and would have almost no noise impacts at these same sites.

Suggested mitigation includes orientating the Lower Site asphalt plant so that the truck entrances face east and west and the exhaust fan is on the south side of the building. Install sound reducing kits on the D6 and D9 bulldozers used on the site. Noise impacts are discussed in detail in the Noise Technical Report.

3.5.3 Impacts of Off-Site Air Quality

The truck traffic generated by the project and its alternatives is substantial. The air quality impacts of increased truck volumes at Exit 34 were analyzed using EPA emission factor model Mobil5b and intersection dispersion model CAL3QHC. (Due to its excellent level of service and minimal existing volumes, Exit 38 was not modeled). The analysis of Exit 32 is not in the air quality scope of work. Air quality impacts at I-90 Exit 34 are discussed in the Air Quality Technical Report. Table 21 summarizes the results of this modeling.

TABLE 20
CUMULATIVE TRUCK EMISSIONS IMPACTS AT THE 146TH INTERSECTION (EXIT 38)

Intersection	CO level	PM10 Level	NAAQS Standards
CO Level	0.6 PPM	9.0 PPM (8-hour)	
PM10 Levels	4.0 ug/m3	50 ug/m3 (24-hour)	

Note: Truck emissions do not come close to the NAAQS and do not pose a significant air quality impact.

3.6 SUMMARY OF PROPOSED MITIGATION MEASURES

3.6.1 Construction Mitigation

Construction traffic impacts could be reduced and minimized by the following:

- Establishing construction periods, typically during daytime hours on weekdays only
- Designating appropriate truck/hauling routes to/from the project site
- Regular sweeping and washing operations on highways and streets along truck haul routes
- Use of native, onsite material to minimize the amount of offsite truck hauling of excavated and fill material
- Permitting oversize loads to/from the site per King County and WSDOT regulations as to time and procedure, loading and bridge use.

3.6.2 Project Mitigation

3.6.2.1 Alternative 1–No Action

No mitigation measures are proposed under Alternative 1. The intersection of 468th Avenue SE and the I-90 eastbound ramps will function at LOS F in the PM peak hour by 2015. A traffic signal may be required to mitigate the LOS F for the I-90 eastbound ramps at 468th Avenue SE (Exit 34).

3.6.2.2 Alternative 2–Proposal: Lower and Upper Site Mining - Exit 34

The traffic analysis of the proposed project shows operational failure (LOS E and F) in both the AM peak and PM peak hour for one movement by 2005 and for additional movements by 2015 and 2025. A traffic model (VISSIM) was developed (see Attachment A, Scenario 4) to test mitigation alternatives. Mitigation alternatives were tested in an effort to improve the operational LOS and to reduce the queue lengths. These model runs were simulated future conditions with varying levels of mitigation during the AM and PM peak Simulation scenarios included:

- Scenario 1: Existing traffic modeled to calibrate the VISSIM model
- Scenario 2: Projected 2005 and 2025 traffic volumes modeled on the existing street system.
- Scenario 3: Projected 2005 and 2025 traffic volumes, including the project-generated vehicle volumes on the existing street system with no mitigation.

- Scenario 4: Projected 2005 and 2025 traffic volumes, including the project-generated vehicle volumes, modeled with a three lane (Two-way left turn lane), on 468th Avenue SE and a turn pocket added to eastbound SE North Bend Way at the intersection with 468th Avenue SE.
- Scenario 5: Projected 2005 and 2025 traffic volumes, including the projected generated vehicle volumes, modeled with a three lane (Two-way left turn lane), on 468th Avenue SE and a turn pocket added to eastbound SE North Bend Way at the intersection with 468th Avenue SE. Also, included in this model is a signal at SE 146th Street and 468th Avenue SE.

Tables 22 and 23 indicate the AM and PM peak hour LOS and Delay for both the HCS and VISSIM modeling as well as the queue lengths generated by the VISSIM model for the mitigation associated with Scenario 4, widening of 468th Avenue SE and SE North Bend Way.

TABLE 21
SCENARIO 4 AM PEAK-HOUR LEVEL OF SERVICE SUMMARY
MITIGATION ON ALTERNATIVE 2 INCLUDING TWLTL AND SIGNAL AT I-90 EB RAMPS

Intersection	2005		2005 VISSIM			2015		2025		2025 VISSIM		
	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]
SE 146th Street/468th Avenue SE												
EB Left, Through, & Right	B	10.5	A	10.0	46	B	11.9	C	16.5	B	12.5	62
WB Left, Through, & Right	C	17.6	F	570.8	1,841	D	30.4	F	456.2	F	1,430.2	2,677
NB Left	A	8.9	A	6.3	141	A	9.2	A	9.6	B	11.1	187
SB Left	A	8.0	A	7.7	0	A	8.3	A	8.6	A	6.9	30
SE North Bend Way/468th Ave SE												
EB Left	B	12.7	D	29.3	95	C	17.7	C	22.7	F	139.3	417
EB Right	B	11.0	A	7.3	69	B	11.7	B	12.8	C	16.0	69
NB Left	A	8.6	A	4.8	121	A	8.9	A	9.3	A	7.3	125
I-90 WB Ramps/468th Ave SE												
WB Left, Through, & Right	B	12.3	B	10.2	102	B	13.9	C	16.8	C	15.6	89
NB Left	A	8.1	A	8.1	39	A	8.3	A	8.6	C	15.7	59
I-90 EB Ramps/468th Ave SE												
EB Left, Through, & Right	B	13.1	A	6.8	157	C	24.4	B	17.3	B	12.2	272
NB Through, & Right	B	14.6	A	9.0	56	C	21.6	B	15.6	B	11.7	66
SB Left	D	41.2	B	14.9	92	C	21.0	F	102.2	B	19.6	131
SB Through	B	13.6	B	11.0	23	B	14.1	B	13.8	B	12.9	23

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculations
[d] Queue Length = 95% maximum length of vehicles waiting to make a movements from VISSIM model calculations measured in feet..
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only critical movements were represented in this table. Other movements have minimal to no delay.

TABLE 22
SCENARIO 4 PM PEAK-HOUR LEVEL OF SERVICE SUMMARY
MITIGATION ON ALTERNATIVE 2 INCLUDING TWLTL AND SIGNAL AT I-90EB RAMPS

Intersection	2005		2005 VISSIM			2015		2025		2025 VISSIM		
	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]
SE 146th Street/468th Avenue SE												
EB Left, Through, & Right	B	11.8	B	12.8	56	B	14.3	D	26.1	F	76.6	210
WB Left, Through, & Right	C	15.2	F	58.0	112	C	24.8	F	155.6	F	1,863.2	1,237
NB Left	A	9.9	B	13.8	259	B	10.7	B	12.1	F	82.8	2,165
SB Left	A	7.8	A	1.5	0	A	8.0	A	8.3	A	1.6	0
SE North Bend Way/468th Ave SE												
EB Left	B	12.5	D	33.3	69	C	18.3	D	25.4	F	1,002.1	2,113
EB Right	B	12.1	A	7.7	69	B	13.9	C	17.4	F	561.6	69
NB Left	A	8.6	A	7.8	43	A	9.1	A	9.9	A	9.5	125
I-90 WB Ramps/468th Ave SE												
WB Left, Through, & Right	B	11.8	B	10.3	102	B	13.7	C	16.8	F	371.6	1,512
NB Left	A	8.5	B	14.0	59	A	9.0	A	9.8	F	55.2	112
I-90 EB Ramps/468th Ave SE												
EB Left, Through, & Right	C	20.1	B	13.3	243	C	20.7	C	32.2	F	104.9	1,670
NB Through, & Right	B	11.0	A	9.3	49	C	31.3	B	12.2	D	38.4	118
SB Left	F	187.7	B	15.2	157	D	47.4	F	459.8	C	22.3	217
SB Through	B	11.0	A	10.0	46	B	14.5	B	12.4	B	11.6	66

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculations
[d] Queue Length = 95% maximum length of vehicles waiting to make a movements from VISSIM model calculations measured in feet..
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only critical movements were represented in this table. Other movements have minimal to no delay.

Tables 24 and 25 indicate the AM and PM peak hour LOS and Delay for both the HCS and VISSIM modeling as well as the queue lengths generated by the VISSIM model for the mitigation associated with Scenario 5, widening of 468th Avenue SE, widening SE North Bend Way, and providing a signal at 468th Avenue SE and SE 146th Street.

TABLE 23
SCENARIO 5 AM PEAK-HOUR LEVEL OF SERVICE SUMMARY
MITIGATION ON ALTERNATIVE 2 INCLUDING TWLTL AND SIGNALS AT I-90EB RAMPS AND 146TH STREET

Intersection	2005		2005 VISSIM			2015		2025		2025 VISSIM		
	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]
SE 146th Street/468th Avenue SE												
EB Left, Through, & Right	B	15.7	B	13.2	39	B	16.0	B	17.4	C	34.5	69
WB Left, Through, & Right	C	23.1	B	18.5	98	C	23.9	C	24.4	C	34.2	164
NB Left	A	5.8	B	11.7	108	B	10.8	B	15.0	B	16.4	194
NB Through & Right	B	11.6	A	8.3	151	B	13.3	B	18.1	A	9.1	197
SB Left	A	7.5	B	14.6	0	A	7.6	A	9.0	C	29.1	20
SB Through & Right	B	10.3	B	10.9	164	B	11.2	B	14.2	B	17.0	282
SE North Bend Way/468th Ave SE												
EB Left	B	12.7	C	24.9	69	C	17.7	C	22.7	F	141.5	476
EB Right	B	11.0	B	8.3	69	B	11.7	B	12.8	D	27.8	69
NB Left	A	8.6	A	4.3	125	A	8.9	A	9.3	A	6.0	125
I-90 WB Ramps/468th Ave SE												
WB Left, Through, & Right	B	12.3	B	10.3	89	B	13.9	C	16.8	C	16.6	151
NB Left	A	8.1	B	10.7	39	A	8.3	A	8.6	C	18.5	59
I-90 EB Ramps/468th Ave SE												
EB Left, Through, & Right	B	13.1	A	7.2	161	C	24.4	B	17.3	B	11.3	236
NB Through, & Right	B	14.6	A	8.8	49	C	21.6	B	15.6	B	12.3	85
SB Left	D	41.2	B	13.6	89	C	21.0	F	102.2	C	21.7	131
SB Through	B	13.6	A	8.9	23	B	14.1	B	13.8	B	11.8	39

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculations
[d] Queue Length = 95% maximum length of vehicles waiting to make a movements from VISSIM model calculations measured in feet..
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only critical movements were represented in this table. Other movements have minimal to no delay.

TABLE 24
SCENARIO 5 PM PEAK-HOUR LEVEL OF SERVICE SUMMARY
MITIGATION ON ALTERNATIVE 2 INCLUDING TWLTL AND SIGNALS AT I-90EB RAMPS AND 146TH STREET

Intersection	2005		2005 VISSIM			2015		2025		2025 VISSIM		
	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]	LOS[a]	Delay[b]	LOS[a]	Delay[b]	LOS[a]	Delay[c]	Queue Length[d]
SE 146th Street/468th Avenue SE												
EB Left, Through, & Right	B	17.5	B	12.0	49	B	17.9	C	21.7	B	12.9	66
WB Left, Through, & Right	B	17.4	B	18.3	72	B	17.7	C	21.3	C	23.6	92
NB Left	B	12.4	A	7.6	89	C	20.1	D	35.1	B	14.9	239
NB Through & Right	A	9.1	A	2.4	92	B	10.5	A	9.0	A	3.3	141
SB Left	A	6.6	A	6.6	0	A	6.6	A	5.3	B	14.6	16
SB Through & Right	B	11.1	A	7.8	161	B	13.5	B	13.6	B	13.2	306
SE North Bend Way/468th Ave SE												
EB Left	B	12.5	C	18.3	43	C	18.3	D	25.4	F	109.7	233
EB Right	B	12.1	A	8.6	69	B	13.9	C	17.4	B	12.6	92
NB Left	A	8.6	A	3.6	33	A	9.1	A	9.9	A	8.3	59
I-90 WB Ramps/468th Ave SE												
WB Left, Through, & Right	B	11.8	B	11.4	108	B	13.7	C	16.8	C	16.9	151
NB Left	A	8.5	A	9.9	56	A	9.0	A	9.8	C	19.8	82
I-90 EB Ramps/468th Ave SE												
EB Left, Through, & Right	C	20.1	B	12.3	256	C	20.7	C	32.2	D	37.9	692
NB Through, & Right	B	11.0	A	9.0	46	C	31.3	B	12.2	B	15.6	69
SB Left	F	187.7	B	15.7	161	D	47.4	F	459.8	C	25.2	233
SB Through	B	11.0	A	9.7	49	B	14.5	B	12.4	B	11.8	85

[a] LOS = Level of Service.
[b] Delay = Average delay per vehicle in seconds.
[c] Delay = Average delay per vehicle in seconds based on VISSIM model calculations
[d] Queue Length = 95% maximum length of vehicles waiting to make a movements from VISSIM model calculations measured in feet..
EB = eastbound, WB = westbound, NB = northbound, SB = southbound
Note: Only critical movements were represented in this table. Other movements have minimal to no delay.

The model results indicate that widening 468th Avenue SE to three lanes and providing a left turn pocket on SE North Bend Way at the intersection with 468th Avenue SE (Scenario 4) does little to improve the LOS throughout the study area for the AM and PM peak periods. Most of the delay and queuing during the PM peak period result from traffic other than that generated by the mining operation (See Attachment A).

Model results for Scenario 5, widening 468th Avenue SE, providing a turn pocket on SE North Bend Way at the intersection with 468th Avenue SE, and signalizing the intersection of 468th Avenue SE and SE 146th Street, vastly improves the LOS and delay while reducing queue lengths throughout the project area. All movements in the year 2005 operate at LOS D or better for both the AM and PM peak hours with the exception of the southbound left at 468th Avenue SE and the I-90 eastbound ramps. Modifications to the signal timing would likely improve this level of service.

Signalization of the intersection of 468th Avenue SE and SE 146th Street would reduce delay for westbound left turns in the AM peak from 1,524.7 seconds to 34.2 seconds, improve the LOS for the westbound approach from F to C, and reduce the queue length on the westbound approach to 164 feet. Although there would be lower volumes exiting the mining operation during the PM peak, traffic on the westbound approach would be delayed significantly by conflicting heavy traffic volumes on SE 468th Avenue. Scenario 5 mitigation would reduce delay on this approach from 806.4 seconds to 23.6 seconds, improve the LOS for westbound approach from F to C, and reduce the queue length on the westbound approach to 92 feet.

The intersection of SE 468th Avenue at SE North Bend Way would operate at an LOS F with or without the project. However, with Scenario 5 mitigation including adding a turn pocket on SE North Bend Way, the delay for the eastbound left turn would be decreased from 173.2 seconds in the AM peak hour to 141.5 seconds. In the PM peak hour, the same Scenario 5 mitigation would decrease delay from 1061.8 seconds to 109.7 seconds. The queue length on the eastbound approach would be reduced to 476 feet in the AM peak and 233 feet in the PM peak.

With Scenario 5 mitigation, improved traffic flow would result in increased gaps in traffic for northbound left turns and all westbound movements at the I-90 westbound ramps during the PM period. Delay would be reduced for northbound left turns from 195.5 seconds to 19.8 seconds, and from 130.5 seconds to 16.9 seconds for westbound left/right turns. LOS would be improved from F to C. In addition, the queue length would be reduced on the northbound approach from to 82 feet and to 151 feet on the westbound approach.

With traffic flow increased on 468th Avenue SE, the traffic flow from I-90 eastbound to northbound 468th Avenue SE also would increase during the PM peak period. Delay for eastbound left turns would be reduced from 643.8 seconds to 37.9 seconds with the Scenario 5 mitigation. Correspondingly, the LOS would improve from F to D and queue length would be reduced to 692 feet.

The capacity analysis shows that major roadway improvements are not, and would not be, warranted along 468th Avenue SE based on the proposed project traffic volume. For safety and operational reasons, some improvements may be warranted to ease the everyday congestion that would occur at the access to the proposed site. Widening 468th Avenue SE to provide a center, two-way left-turn lane at this location would improve truck turning conditions by allowing through traffic to bypass queued vehicles turning in and out of the Lower Site and/or the Seattle East Auto Truck Plaza. Mitigation measures proposed for this improvement include the following:

- Widen 468th Avenue SE to three lanes from the I-90 eastbound ramps through the intersection of SE 146th Street/Seattle East Auto Truck Plaza driveway. The transition from three to two lanes should begin to the north of SE 146th Street and end near the north gate of Seattle East Auto Truck Plaza. Future development could continue the left-turn lane farther north when warranted. An 8-foot shoulder or curb, gutter, and sidewalk should be provided along the outside edge of the north- and southbound lanes for emergency parking/access and bicycle and pedestrian use.

- Installation of a traffic signal at SE 146th Street and 468th Avenue SE intersection has been identified as a reasonable mitigation measure to reduce the LOS at this intersection to below LOS F, an acceptable level under County Code. A warrant analysis was performed for each of the three design years and is included as an attachment to the Transportation Technical Report. The warrant analysis revealed that a signal is not warranted, however, based on the significant improvement in the level of service and the reduction in queue lengths throughout the project area, a signal is recommended. While installation of the signal would not otherwise be required under County standards at this time, SEPA provides permit decisionmakers with authority to require reasonable measures to mitigate significant adverse environmental impacts. Such SEPA mitigation authority extends even beyond those standards that would otherwise be required under a strict application of County Code.
- Require a truck turning template analysis in the southeast corner by the motel during permitting.
- The permit should additionally include provisions requiring that the applicant continue to monitor future conditions along the corridor of 468th Avenue SE between I-90 eastbound ramps and SE 144th Street. This monitoring should provide updated operational analysis of the corridor for the life of the Proposal. In the event that the County determines as part of its five-year periodic review processes, that future Project-related conditions warrant alternative mitigation measures, such as potential signalization of the I-90 eastbound ramps or reevaluation of the signal location at 468th Avenue SE and SE 146th Street, Cadman, Inc. should be required to either construct or contribute to the construction of such measures.
- Complete installation of an 8-foot-wide paved shoulder along 468th Avenue SE from the I-90 ramps to SE North Bend Way.
- Improve signs and pavement marking at existing crossing locations on 468th Avenue SE and SE 146th Street, as necessary.
- Install continuous illumination from I-90 Exit 34 through the required channelization improvements along 468th Avenue SE.
- Restrict truck traffic from the Lower Site to use only SE 146th Street and 468th Avenue SE between SE 146th Street and the I-90 Exit 34 ramps, with the exception of trucks making local deliveries.
- Pay MPS fees for King County planned improvement projects.
- Construct an eastbound right-turn lane on SE North Bend Way at 468th Avenue SE.

Implementation of the improvements described above, including the left-turn lane and widening of the shoulders would eliminate blockage caused by trucks waiting to turn into Seattle East Auto Truck Plaza and out of the project site onto 468th Avenue SE. This widening would also allow room for vehicles to pull out of the way of emergency vehicles or for emergency services to bypass congested areas. Installing a traffic signal in the future at the intersection of 468th Avenue SE and the I-90 eastbound off-ramp would improve the LOS from LOS F to LOS D by year 2025. Other safety improvements that should be evaluated and implemented by others, if justified, include:

- Lower the speed limit along 468th Avenue SE to a consistent 25 mph between SE North Bend Way and SE Middle Fork Road.
- Post "No Parking" signs along 468th Avenue SE segments that are occasionally used for truck parking and when I-90 is closed.

Construction traffic impacts could be reduced and minimized by the following:

- Establishing construction periods, typically during daytime hours on weekdays only
- Designating appropriate truck/hauling routes to/from the project site
- Regular sweeping and washing operations on highways and streets along truck haul routes
- Using native, onsite material to minimize the amount of offsite truck hauling of excavated and fill material
- Permitting oversize loads to/from the site in accordance with King County and WSDOT regulations as to time and procedure, loading, and bridge use.

ALTERNATIVE 2A–UPPER SITE MINING AND LIMITED LOWER SITE MINING - EXIT 34
Project mitigation for the Lower Site Option would be the same as listed under Alternative 2 above.

3.6.2.3 Alternative 3–Lower and Upper Sites Mining - Exits 34 and 38)

Mitigation for Alternative 3 should include all the improvements along 468th Avenue SE as proposed for Alternative 2. In addition, improvements to SE Grouse Ridge Road and the operation of the bridge would be needed for project operations (see Figure 14-17). As a primary local user of SE Homestead Valley Road, the project should also contribute to improvements to bring this roadway up to current King County road standards. A summary of these proposed mitigation improvements include:

- Because SE Grouse Ridge Road is too narrow for safe truck traffic operations in both directions in most locations, the roadway should be widened to two lanes following King County standards to permit truck traffic in both directions. Figure 14-17 shows a sketch of the roadway and illustrates the approximate locations that would need improving, which includes some realignment to remove blind spots.
- If agreed upon by the local private parties that own and use SE Grouse Ridge Road, the existing bridge over the South Fork of the Snoqualmie River (owned by the State Patrol Fire Academy/State police) could remain as a one-way operation. Only one truck should be allowed on the bridge at a time. Stop signs and bridge signage would be installed to minimize deterioration of the existing bridge superstructure. Otherwise, to accommodate two lanes of traffic, a new bridge parallel to the old one at 0.2 mile would likely need to be built.

Environmental issues associated with a second bridge would require additional analysis. The road on the north/west/uphill end of the bridge should be realigned and sight distance improved. Fills and blasting of rock in several locations would be necessary to widen the road. Blind curves along the road and approaching the bridge would have to be straightened to improve safety. To accommodate trucks, many trees and branches would need to be removed.

- The remaining section of SE Homestead Valley Road should be widened for shoulders and a pavement overlay would be finished. This would support truck volumes and provide safe passage of pedestrian and bicycle traffic conflicting with proposed truck traffic. Rehabilitation of the roadway structure over a 10- to 20-year period would need to be agreed upon but would likely include repair of existing concrete panels. Non-destructive *in-situ* testing, pavement coring, and laboratory testing would provide better information and an increased level of confidence in future roadway performance predictions. Mitigation should include safety improvements to two small bridges over creeks that cross under this section of SE Homestead Valley Road.

ALTERNATIVE 3A–UPPER SITE MINING AND LIMITED LOWER SITE MINING - EXITS 34 AND 38

Project mitigation for the Lower Site Option would be the same as listed under Alternative 3 above.

3.6.2.4 Alternative 4–Upper Site Mining - Exit 38

The same mitigation improvements as noted under Alternative 3 and as shown in Figure 14-10 should be required for SE Grouse Ridge Road, Exit 38-SE Homestead Valley Road, and their respective bridges. No improvements would be required along or in the area of 468th Avenue SE including I-90 Exit 34. The same mitigation improvements as noted under Alternative 3 and as shown in Figure 17 would be required for SE Grouse Ridge Road, SE Homestead Valley Road and their related bridges. No improvements would be required along or in the area of 468th Avenue SE.

3.6.3 Significant Unavoidable Adverse Impacts

All significant measurable adverse transportation impacts could and would be mitigated by the above measures. The FEIS has concluded that under Alternative 2 (the preferred alternative), by 2005, the westbound leg of the SE 146th Street and 468th Avenue SE intersection would be operating at LOS F. Under County Code, the change to LOS F is deemed to be a significant adverse environmental impact. Installation of a traffic signal at the intersection of SE 146th Street and 468th Avenue SE has been identified within this FEIS as a reasonable mitigation measure to reduce the LOS at this intersection to below LOS F, an acceptable level under County Code. While installation of the signal would not otherwise be required under County standards at this time, SEPA provides permit decisionmakers with authority to require reasonable measures to mitigate significant adverse environmental impacts. Such SEPA mitigation authority extends even beyond those standards that would otherwise be required under a strict application of County Code.

For County roads (such as 468th Avenue SE and SE Homestead Valley Road) and State roads (I-90 interchanges), mitigation measures for the proposed project would be accomplished by either making payments of applicable traffic impact fees and/or implementing access and public road improvements in the project area. Mitigation of traffic impacts on the City of North Bend street system could be accomplished by negotiating a voluntary road improvement or fee payment agreement with the City and County, drawing from the suggestions provided above in Section 14.3, Mitigation Measures. No significant unavoidable adverse project-related impacts from transportation are expected.

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ATTACHMENT A

INNOVATIVE TRANSPORTATION CONCEPTS (ITC) REPORT

200 Mill Avenue, Suite 410
Renton WA 98055

Introduction

Cadman, Inc. has applied to the King County Department of Development and Environmental Services (DDES) for a permit to mine sand and gravel on two sites, approximately 317 acres in total size. The sites are located north of Interstate 90 and west of 468th Street/Exit 34, just east of the city of North Bend. According to Cadman's proposal, mineral extraction from the lower site would occur first with subsequent conversion into a processing center for upper site (Grouse Ridge) material. The anticipated life span of the mine is approximately 25 years.

Initially, the site would be used to supply direct sales of unprocessed materials to its customers and other Cadman facilities. In the future, as market conditions allow, a concrete batch plant and/or an asphalt batch plant could be built on the site. For the purpose of the concurrency analysis, all potential operations are included in the trip generation estimate. At its peak, the site is expected to produce up to 1.5 million tons of gravel, 75,000 cubic yards of concrete, and 150,000 tons of asphalt each year. Volume during the peak construction month typically represents about 15% of the annual production. The site would employ approximately 20 people at full production.

This technical memorandum addresses the potential impacts to traffic and transportation facilities from the proposed development of a gravel extraction and processing operation on the east side of North Bend, Washington. The resulting model simulations using the VISSIM simulation software suite are based on data and other information provided by URS Inc. to Innovative Transportation Concepts Inc. (ITC). The simulations include alternative conditions including different mitigation alternatives such as signalizing intersections and re-channelizing roadway sections to provide left turn facilities.

Future Conditions

The proposed project would result in vehicle trips to/from the site by site-based employees; and it would involve the use of large trucks to haul mined materials to their ultimate market. The site would operate between 7 am and 5:30 pm. Associated estimates that average weekday site-based employees would range from 60 to 65. Each would make a trip to and from the site each day, and generally remain on-site all day. Employee trips are estimated at 62 per day, with 31 moving to the site between 6 and 8 in the morning, and 31 leaving the site between 4 and 6 in the afternoon.

Haul truck drivers would normally work an 8-hour shift plus lunch break over the five weekdays of each week. Therefore, a normal shift of truck drivers would likely be from 6:30-7:30 am to 3:00-3:30 pm. On a normal workday, haul-truck activity would end by 3:30 pm. Between 7 am and 3 pm truck movements through North Bend would average 98 per hour when peak hauling operations were reached (assumed by Cadman). Truck activity would "ramp-up" between 6:30 and 7 am, and "ramp-down" between 3 and 3:30 pm. On normal haul days, there would be minimal truck hauling activity during the 4-5 pm peak traffic hour on the study area road system. Total weekday truck trips would average no more than 936 with 5-day operations (468 each direction).

Average-day trip generation for the North Bend Gravel Operation site was determined using the above rates and the average daily production of gravel and concrete. The average daily production assumes that the annual production is evenly distributed among 306 production days per year. Each day represents approximately 0.3% of the annual production. Table 1 summarizes the average daily production and the number of trips generated during the average day.

Table 1: Trip Generation Rates[1]

Vehicle Type	Daily Trips			AM Peak Hour [4]			PM Peak Hour [4]		
	Trip Rate	% In	% Out	Trip Rate	% In	% Out	Trip Rate	% In	% Out
Gravel Trucks [1]	80.0 trips per 1,000 tons/day	50%	50%	8.4 trips per 1,000 tons/day	40%	60%	1.4 trips per 1,000 tons/day	63%	17%
Concrete Trucks [2]	25.0 trips per 100 cy/day	50%	50%	2.6 trips per 100 cy/day	0%	100%	0.4 trips per 100 cy/day	100%	0%
Asphalt Trucks [3]	66.7 trips per 1,000 tons/day	50%	50%	7.0 trips per 1,000 tons/day	0%	100%	1.2 trips per 1,000 tons/day	100%	0%
Passenger Vehicles [4]	3.1 trips per employee	50%	50%	0.25 trips per employee	80%	20%	0.4 trips per employee	16%	84%

1. Daily trip rate assumes each gravel truck carries an average of twenty-five tons.
2. Daily trip rate assumes each concrete truck carries an average of eight cubic yards. Peak hour trip rates based on the same proportion as gravel trucks.
3. Daily trip rate assumes each asphalt truck carries an average of 30 tons. Peak hour trip rates based on the same proportion as the gravel trucks.
4. Derived from three days of truck and passenger vehicle counts at Cadman's existing quarry near Monroe, WA.

[1] Information contained supplied by URS.

The VISSIM Model

VISSIM is a microscopic, time step and behavior based simulation model developed to analyze the full range of functionally classified roadways and public transportation systems. VISSIM can model integrated roadway networks found in a typical corridor as well as various modes consisting of general purpose traffic, buses, HOV, light rail, heavy rail, trucks, pedestrians, and bicyclists. The model was developed at the University of Karlsruhe, Germany during the early 1970s. Commercial distribution of VISSIM began in 1993 by PTV Transworld AG, who continues to distribute and maintain VISSIM today. VISSIM version 3.50 was used in this study.

The model consists of two primary components: (1) simulator and (2) signal state generator (SSG). The simulator generates traffic and is where the user graphically builds the network. The user begins by importing an aerial photo or schematic drawing of the study area into the simulator. Next, the user begins "drawing" the network and applying attributes (e.g., lane widths, speed zones, priority rules, etc.). Although links are used in the simulator, VISSIM does not have a traditional node structure. The lack of nodes provides the user with the flexibility to control traffic operations (e.g., yield conditions) and vehicle paths within an intersection or interchange.

The SSG is separate from the simulator. It is where the signal control logic resides. Here, the user has the ability to define the signal control logic and thus emulate any type of control logic found in a signal controller manufacturer's firmware. The SSG permits the user to analyze the impacts of signal operations including, but not limited to: fixed time, actuated, adaptive, transit signal priority, and ramp metering. It is important to note that fixed time control can be implemented in the simulator. The SSG reads detector information from the simulator every time step. Based on the detector information, the SSG decides the status of the signal display during the subsequent time step.

VISSIM provides a variety of user definable MOEs. These MOEs include: system, intersection, and person delay, travel times, stops, queue lengths, and emissions.

Objectives

ITC calibrated the VISSIM base model (existing conditions) to reflect current traffic operations conditions in the study area using a client-provided videotape of study area conditions. The videotape showed current speeds, truck movements in and out of the truck stop area, truck acceleration and gap acceptance behavior. In addition, ITC utilized information about the operational characteristics (e.g. length, acceleration, and deceleration) of the new gravel trucks to realistically model traffic generated by the gravel pit. The area of potential traffic impact includes the following interchanges, roadways and highways in the vicinity of the proposed mining operation:

- Exit 34 (468th Avenue SE or Edgewick Road)
- 468th Ave. SE between the freeway and SE 146th St.
- Intersections at

- 468^{th} Ave. SE & SE 146^{th} St.
- 468^{th} Ave. SE & SE North Bend Way

The traffic and transportation simulated impacts within this technical memorandum are limited to that study area. Differing scenarios were simulated based on current data and future projected volumes from not only the gravel pit but from the other major trip generators in the immediate vicinity including Ken's Truck Stop and the I-90 exit # freeway ramps.

Congestion is measured by different methodologies including delay and intersection level of service (LOS) among the leading indicators. The most common measurement may be the LOS. Level of service (LOS) is a measure of the quality of traffic flow. It is rated from A to F, with A representing free-flow conditions and F representing serious congestion. The latest edition of the Highway Capacity Manual measures LOS at street intersections in terms of average delay per approaching vehicle in seconds. More detailed descriptions for the LOS grades at intersections follow:

- LOS A - Minimal average delay ≤10 seconds; traffic progression through signalized intersections is extremely favorable, and most vehicles arrive during the green phase.

- LOS B - Traffic volume begins to affect freedom of flow. Average delay >10 – 20 seconds (>10 - 15 seconds for unsignalized intersections).

- LOS C - Traffic volumes start causing longer cycles at signalized intersections; some signal phases may occasionally fail to clear waiting queues. Average delay >20 - 35 seconds (>15 – 25 seconds for unsignalized intersections). Considered acceptable condition in suburban areas.

- LOS D - Motorists perceive the influence of congestion; individual signal phase and cycle failures become more frequent. Average delay >35 – 55 seconds (>25 – 35 seconds for unsignalized intersections). Considered a minimum standard in suburban areas.

- LOS E - Intersection operates at or near capacity; individual signal phases and cycles frequently occur. Average delay >55 – 80 seconds (>35 – 50 seconds for unsignalized intersections). Considered by most agencies as the tolerable limit of acceptable delay in urban areas.

- LOS F - Over-capacity condition characterized by stop delays for all vehicles, and failure to clear approach queues during most signal cycles. Average delay >80 seconds (>50 seconds for unsignalized intersections). Unacceptable condition in urban areas, if correctable.

The model simulations conducted by ITC Inc. were based on the following scenarios and each scenario's major observations are documented below. The following information should be viewed in conjunction with the model runs themselves to provide an accurate view of the study area to determine the effectiveness of the mitigations implemented. The simulation results from the modeling efforts are contained in the electronic files accompanying this technical memorandum.

Alternatives Analysis

Scenario 1

Conditions: Existing conditions

This model run is conducted to calibrate the model and includes the placement of channelization devices; lane widths, intersection geometries, and other infrastructure facilities to ensure the model accurately reflect the true conditions at the study site. All intersections are two-way stop controlled. No output was generated from the model.

Scenario 2

Conditions: Future year (2005 and 2025) – No Build with signalized intersection at 468th Ave SE & Eastbound I-90 Ramps

These model runs were conducted to simulate future conditions during the AM and PM peak hours with a projected increase in background traffic volumes to the year 2005 and 2025. Additional projected traffic volumes generated from future developments are also included. Signal timing was optimized for the intersection on 468th Ave SE at the I-90 Eastbound Ramps. The differences between Scenario 1 and Scenario 2 are the following:

- Projected 2005 and 2025 traffic volumes are simulated
- The intersection at 468th Ave SE & Eastbound I-90 Ramps is projected to be signalized before the year 2005 and the signal is included in all models

Average control delays, Level-of-Service and 95th percentile maximum back of queue length were generated from the VISSIM simulation models for AM and PM peak hours. Results are shown in **Tables 1, 5, 9 and 13** in **Appendix A** and **Tables 1, 5, 9 and 13** in **Appendix B**.

Scenario 3

Conditions: Future year (2005 & 2025) – Build with signalized intersection at 468th Ave SE & Eastbound I-90 Ramps

These model runs were conducted to simulate future conditions during the AM and PM peak hours with a projected increase in background traffic volumes to the year 2005 and

2025. Additional projected traffic volumes generated from future developments and the mining operation are also included. Traffic volumes exiting the mining operation include 68 heavy gravel trucks per hour during the AM peak period. Traffic exiting the mining operation enters the study area traveling west on SE 146th St then travels south on 468th Ave SE and exits on the I-90 westbound ramps. Traffic entering the mining operation enters the study area on the I-90 Eastbound ramps then travels north on 468th Ave SE and east on SE 146th St to the site. Signal timing was optimized for the intersection on 468th Ave SE at the I-90 Eastbound Ramps. The differences between scenario 2 and scenario 3 are the following:

- Projected 2005 and 2025 traffic volumes with mining operation traffic is simulated

Average control delays, Level-of-Service and 95th percentile maximum back of queue length were generated from the VISSIM simulation models for AM and PM peak hours. Results are shown in **Tables 2, 6, 10** and **14** in **Appendix A** and **Tables 2, 6, 10** and **14** in **Appendix B**.

Scenario 4

Conditions: Future year (2005 & 2025) 3-lane section with TWLTL and signalized intersection at 468th Avenue SE and Eastbound I-90 Ramps

These model runs were conducted to simulate future conditions during the AM and PM peak hours with a projected increase in background traffic volumes to the year 2005 and 2025. Additional projected traffic volumes generated from future developments and the mining operation are also included. Signal timing was optimized for the intersection on 468th Ave SE at the I-90 Eastbound Ramps. The differences between scenario 3 and scenario 4 are the following:

- A 3-lane section on 468th Ave SE with TWLTL extending between the north driveway of Ken's Truck Stop and I-90 Eastbound Ramps
- Eastbound left turn lane added at North Bend Way

Average control delays, Level-of-Service and 95th percentile maximum back of queue length were generated from the VISSIM simulation models for AM and PM peak hours. Results are shown in **Tables 3, 7, 11** and **15** in **Appendix A** and **Tables 3, 7, 11** and **15** in **Appendix B**.

Scenario 5

Conditions: Future year (2005 and 2025) with mitigation of 3-lane section with TWLTL and signalized intersections at 468th Avenue SE and SE 146th St., and Eastbound I-90 Ramps

These model runs were conducted to simulate future conditions during the AM and PM peak hours with a projected increase in background traffic volumes to the year 2005 and 2025. Additional projected traffic volumes generated from future developments and the mining operation are also included. Signal timing at the I-90 eastbound ramps and for mitigation was optimized. The differences between scenario 4 and scenario 5 are the following:

- Additional Signalization on 468th Ave. SE at SE 146th St.

Average control delays, Level-of-Service and 95th percentile maximum back of queue length were generated from the VISSIM simulation models for AM and PM peak hours. Results are shown in **Tables 4, 8, 12** and **16** in **Appendix A** and **Tables 4, 8, 12** and **16** in **Appendix B**.

Conclusions

Year 2005

Mitigation of the study area significantly improved the level of service for the westbound left turning movement from SE 146th St on to 468th Ave SE. Signalization of 468th Ave SE at SE 146th St allows left-turning heavy gravel trucks to proceed through the intersection with having to choose a gap in conflicting traffic. During the AM peak period, delay was reduced for westbound left-turns in the AM peak period from 886.8 seconds (scenario 3) and 572.6 seconds (scenario 4) to 18.5 seconds (scenario 5), improved level-of-service for westbound left-turns from F (scenarios 3 and 4) to B (scenario 5), and reduced the 95th percentile maximum queue length on the westbound approach from 2671 feet (scenario 3) and 1841 feet (scenario 4) to 98 feet (scenario 5). Mitigation reduced delay on this approach in the PM peak period from 62.0 seconds (scenario 2), 142.1 seconds (scenario 3) and 62.5 seconds (scenario 4) to 20.0 seconds (scenario 5) for westbound left-turns, improved level-of-service for westbound left-turns from F (scenarios 2, 3 and 4) to B (scenario 5), and reduced the 95th percentile maximum queue length on the westbound approach from 171 feet (scenario 3) and 112 feet (scenario 4) to 72 feet (scenario 5). Mitigation also reduced the northbound left-turn 95th percentile maximum queue length from 468th Ave SE to SE 146th St during the PM peak period. These queue lengths were reduced from 289 feet (scenario 2), 433 feet (scenario 3) and 259 feet (scenario 4) to 89 feet (scenario 5).

Adding an eastbound left-turn pocket at the intersection of 468th Ave SE at SE North Bend Way has very little impact during the AM or PM peak periods except for the PM peak period delay and level-of-service. Eastbound left-turning movement delay was reduced from 33.1 seconds (scenario 2), 44.1 seconds (scenario 3) and 33.3 seconds (scenario 4) to 18.3 seconds (scenario 5) and level-of-service was improved from D (scenarios 2 and 4), and E (scenario 3) to C (scenario 5). Eastbound right-turning movement delay was reduced from 17.5 seconds (scenario 2), 17.2 seconds (scenario 3) and 11.1 seconds (scenario 4) to 8.2 seconds (scenario 5) and level-of-service was improved from C (scenarios 2 and 3), and B (scenario 4) to A (scenario 5). During the PM peak period, delay was reduced for the northbound left turning movement from 13.3 seconds (scenario 2) and 14.2 seconds (scenario 3) to 7.8 seconds (scenario 4) and 3.6 seconds (scenario 5). Level-of-service was improved from B (scenarios 2 and 3) to A (scenarios 4 and 5). The 95th percentile maximum queue length for the northbound left turning movement was reduced from 331 feet (scenario 2) and 325 feet (scenario 3) to 43 feet (scenario 4) and 33 feet (scenario 5).

With the exception of delayed traffic on SE 146th St at 468th Ave SE (AM and PM peak periods for scenarios 2, 3 and 4) and on North Bend Way at 468th Ave SE (PM peak period for scenario 3), there were no significant problems during the 2005 AM or PM peak periods.

Year 2025

Mitigation of the study area vastly improves the level of service throughout the study area for the year 2025 AM and PM peak periods. Most of the delay and queuing during the PM peak period result from traffic not generated by the mining operation.

Signalization of the intersection of 468th Ave SE and SE 146th St allows heavy gravel trucks exiting the mining operation to travel though the intersection without choosing a gap in conflicting traffic. During the AM peak period, mitigation reduced delay for westbound left-turns from 51.1 seconds (scenario 2), 1516.3 seconds (scenario 3) and 1434.1 seconds (scenario 4) to 34.1 seconds (scenario 5), improved level-of-service for westbound left-turns from F (scenarios 2, 3 and 4) to C (scenario 5), and reduced the 95th percentile maximum queue length on the westbound approach from 2703 feet (scenario 3) and 2677 feet (scenario 4) to 164 feet (scenario 5). The intersection delay in scenario 5 is 15.2 seconds corresponding to a level-of-service B. Although there is less volume exiting the mining operation during the PM peak period, 2025 traffic on the westbound approach is delayed significantly by conflicting heavy traffic volumes northbound and southbound on SE 368th Ave. Mitigation reduced delay for westbound left-turns from 325.6 seconds (scenario 2), 820.1 seconds (scenario 3) and 1789.7 seconds (scenario 4) to 27.3 seconds (scenario 5), improved level-of-service for westbound left-turns from F (scenarios 2, 3 and 4) to C (scenario 5), and reduced the 95th percentile maximum queue length on the westbound approach from 253 feet (scenario 2), 1093 feet (scenario 3) and 1237 feet (scenario 4) to 92 feet (scenario 5). Mitigation also reduced the northbound left-turn delay during the PM peak period from 44.4 seconds (scenario 2), 42.6 seconds (scenario 3) and 82.8 seconds (scenario 4) to 14.9 seconds (scenario 5), improved level-of-service for westbound left-turns from E (scenarios 2 and 3) and F (scenario 4) to B (scenario 5), and reduced the 95th percentile maximum queue length from 2385 feet (scenario 2), 2365 feet (scenario 3) and 2165 feet (scenario 4) to 239 feet (scenario 5). The intersection delay in scenario 5 is 10.5 seconds corresponding to a level-of-service B.

Adding an eastbound left-turn pocket at the intersection of SE 468th Ave at SE North Bend Way significantly improves traffic entering 468th Ave SE from SE North Bend Way. Eastbound left-turning movement delay was not significantly reduced during the AM peak period and level-of-service remained at F for all scenarios. However, the 95th percentile maximum queue length for the eastbound left-turning movement was reduced from 863 feet (scenario 2) and 810 feet (scenario 3) to 417 feet (scenario 4) and 476 feet (scenario 5). Eastbound right-turning movement delay during the AM peak period was reduced from 165.7 seconds (scenario 2) and 189.5 seconds (scenario 3) to 16.0 seconds (scenario 4) and 27.8 seconds (scenario 5) and level-of-service was improved from F (scenarios 2 and 3), to C (scenario 4) and D (scenario 5). Eastbound left-turning movement delay during the PM peak period was reduced from 1099.4 seconds (scenario 2), 874.1 seconds (scenario 3) and 1002.1 seconds (scenario 4) to 109.7 seconds (scenario 5), level-of-service remained at F for all scenarios and the 95th percentile maximum queue length was reduced from 2126 feet (scenario 2), 2096 feet (scenario 3) and 2113 feet (scenario 4) to 233 feet (scenario 5). Eastbound right-turning movement delay was reduced from 1033.4 seconds (scenario 2), 779.6 seconds (scenario 3) and 561.6 seconds (scenario 4) to 12.6 seconds (scenario 5), level-of-service was improved from F (scenarios 2, 3 and 4), to B (scenario 5) and the 95th percentile maximum queue length was reduced from 2126 feet (scenario 2), 2096 feet (scenario 3) to 69 feet (scenario 4) and 92 feet (scenario 5). During the AM peak period, delay was reduced for the northbound left-turning movement from 23.4 seconds (scenario 2) and 22.4 seconds (scenario 3) to 7.3 seconds (scenario 4) and 6.0 seconds (scenario 5). Level-of-service was improved from C (scenarios 2 and 3) to A (scenarios 4 and 5). The 95th percentile maximum queue length for the northbound left turning movement was reduced from 518 feet (scenario 2) and 482 feet (scenario 3) to 125 feet (scenario 4) and 125 feet (scenario 5). During the PM peak period, delay was reduced for the northbound left-turning movement from 71.3 seconds (scenario 2) and 59.9 seconds (scenario 3) to 9.5 seconds (scenario 4) and 8.3 seconds (scenario 5). Level-of-service was improved from F (scenarios 2 and 3) to A (scenarios 4 and 5). The 95th percentile maximum queue length for the northbound left turning movement was reduced from 1158 feet (scenario 2) and 1152 feet (scenario 3) to 125 feet (scenario 4) and 59 feet (scenario 5).

Improved system traffic flow with mitigation increased gaps in traffic for northbound left-turns and all westbound movements at the I-90 westbound ramps during the PM period. Delay was reduced for northbound left-turns from 208.5 seconds (scenario 2), 210.8 seconds (scenario 3) and 55.2 seconds (scenario 4) to 19.8 seconds (scenario 5), from 205.5 seconds (scenario 2), 133.4 seconds (scenario 3) and 379.1 seconds (scenario 4) to 15.3 seconds for westbound right-turns and from 141.1 seconds (scenario 2), 107.5 seconds (scenario 3) and 307.3 seconds (scenario 4) to 30.9 seconds for westbound left-turns. Level-of-service was improved from F (scenarios 2, 3 and 4) to C (scenario 5) for northbound left-turns, F (scenarios 2, 3 and 4) to C (scenario 5) for westbound right-turns and F (scenarios 2, 3 and 4) to D (scenario 5) for westbound left-turns. Finally, the 95th percentile maximum queue length was reduced for northbound left-turns from 768 feet (scenario 2) and 778 feet (scenario 3) to 112 feet (scenario 4) and 82 feet (scenario 5), and from 761 feet (scenario 2), 600 feet (scenario 3) and 1512 feet (scenario 4) to 151 feet for the westbound approach.

Since traffic flow increased on 468th Ave SE, the traffic flow from I-90 eastbound to northbound 468th Ave SE also increased during the PM peak period. Eastbound left-turning movement delay was reduced from 660.2 seconds (scenario 2), 646.6 seconds (scenario 3) and 105.8 seconds (scenario 4) to 38.4 seconds (scenario 5), level-of-service improved from F (scenarios 2, 3 and 4) to D (scenario 5) and the 95th percentile maximum queue length was reduced from 2405 feet (scenario 2), 2388 feet (scenario 3) and 1670 feet (scenario 4) to 692 feet (scenario 5). Northbound through movement delay was reduced from 90.2 seconds (scenario 2) and 86.2 seconds (scenario 3) to 26.4 seconds (scenario 4) and 12.2 seconds (scenario 5), level-of-service improved from F (scenarios 2, and 3) to C (scenario 4) and B (scenario 5) and the 95th percentile maximum queue length was reduced from 246 feet (scenario 2) and 249 feet (scenario 3) to 118 feet (scenario 4) and 69 feet (scenario 5). Intersection delay was reduced from 257.7 seconds (scenario 2), 265.9 seconds (scenario 3) and 62.7 seconds (scenario 4) to 27.5 seconds (scenario 5) and level-of-service improved from F (scenarios 2 and 3) and E (scenario 4) to C (scenario 5).

ATTACHMENT B

PAVEMENT EVALUATIONS

PAVEMENT EVALUATION
S.E. HOMESTEAD VALLEY ROAD
I-90 EXIT 38 EAST TO EXIT 38 WEST
NORTH BEND, WASHINGTON

This memo summarizes the results of our pavement evaluation of S.E. Homestead Valley Road from Exit 38 West to Exit 38 East on I-90 in North Bend, Washington. Our evaluations were based upon a visual examination of the existing roadway and a review of original construction contract documents (Washington State Highway Commission, 1953) for S.E. Homestead Valley Road, formerly known as State Highway No. 2.

Roadway Description

Figure 1 illustrates the location of S.E. Homestead Valley Road and State Highway No. 2, which generally parallels the South Fork of the Snoqualmie River in a southeast to northwest direction. The stationing shown on Figure 1 corresponds to State Highway No. 2 contract drawings (Washington State Highway Commission, 1953).

From about station 690+00 at I-90 Exit 38 East to about station 800+00, S.E. Homestead Road follows the former State Highway No. 2 alignment. At about station 800+00, S.E. Homestead Rd. turns north from the old State Highway No. 2 alignment and connects with I-90 Exit 38 West at a distance of about 500 feet.

State Highway No. 2 was constructed in 1953 as a 4-lane highway with asphaltic concrete (AC) pavement and Portland cement concrete (PCC) pavement sections. Portions of an existing PCC roadway were resurfaced with AC pavement and incorporated into State Highway No. 2. Table 1 summarizes the original State Highway No 2 pavement sections.

TABLE 1
Original State Highway No. 2 Pavement Sections[*]

Type	Base Course Material	Pavement Section
A	10 inches of compacted Select Borrow at roadway shoulders	2-inches AC over 7 to 10 inches of existing PCC
B and E	10 inches of compacted Select Borrow	4 inches AC
C and D	6 inches of compacted Select Borrow	8 inches PCC

(*) Reference: Washington State Highway Commission, 1953

Old State Highway No. 2 has been modified to create the current 2-lane S.E. Homestead Road alignment and pavement sections. S.E. Homestead Valley Road now occupies either the east-bound or westbound lanes of State Highway No. 2. Curved alignment segments have been filled to modify the transverse roadway slope and between 2 to 4 inches of new AC surfacing has been placed on some segments of the existing State Highway No. 2 pavements.

Subgrade Support

Cutting and filling the original topography was required to achieve the roadway profile. State Highway No. 2 construction drawings indicate that all topsoil, organic materials, and other "un-suitable materials" were stripped from the roadway alignment prior to placing fill or pavement sections.

Geologic maps and our site reconnaissance indicate that the native subgrade soils consist of compact granular glacial soils. The fill soils consist of compacted "Embankment Material" and "Select Borrow." The embankment materials would likely have consisted of the excavated granular glacial soils. Select borrow material was placed as pavement base course material and likely consisted of imported clean sand and gravel. New fill for regrading the alignment curves consisted of clean sand and gravel.

Visual observations indicate that the surface water runoff is controlled at the outside edge of the roadway shoulders by a system of drainage ditches and culverts that redirect water to the South Fork Snoqualmie River. Some portions of the roadway drainage system are inadequate and re-sult in ponded water on the edges of the roadway. Ponded water was observed on the south side of the road between about station 709+00 to 710+00, on the north side of the road between about stations 771+00 to 775+00.

Existing Pavement Conditions

The pavement conditions along S.E. Homestead Rd. were evaluated based on our visual recon-naissance and a review of the original construction contract documents (Washington State High-way Commission, 1953). Tables 2 through 4 summarize the AASHTO (1993) pavement severity distress descriptions used in the evaluations.

TABLE 2
AASHTO Flexible Pavement Distress
Severity Descriptions

Low:	Longitudinal disconnected hairline cracks running parallel to each other. The cracks are not spalled. Initially there may only be a single crack in the wheel path.
Moderate:	Further development of low-severity alligator cracking into a pattern of pieces formed by cracks that may be lightly surface-spalled. Cracks may be sealed.
High:	Medium alligator cracking has progressed so that pieces are more severely spalled at the edges and loosened until the cells rock under traffic. Pumping may exist.

TABLE 3
AASHTO Concrete Pavement Distress
Corner Break Severity Descriptions

Low:	Crack is tight (hairline). Well-sealed cracks are considered tight. No faulting or break-up of broken corner exists. Crack is not spalled.
Moderate:	Crack is working and spalled at medium severity, but break-up of broken corner has not occurred. Faulting of crack or joint is less than ½ inch. Temporary patching may have been placed because of corner break.
High:	Crack is spalled at high severity, the corner piece has broken into two or more pieces, or faulting of crack or joint is more than ½ inch.

TABLE 4
AASHTO Concrete Pavement Distress
Transverse and Diagonal Crack Severity Descriptions

Low:	Hairline (tight) crack with no spalling or faulting; a well-sealed crack with no visible faulting or spalling.
Moderate:	Working crack with low- to medium-severity level of spalling, and/or faulting less than ½ inch. Temporary patching may be present.
High:	A crack with width of greater than 1 inch; a crack with a high-severity level of spalling; or a crack faulted ½ inch or more.

Table 5 summarizes pavement sections subgrade conditions and pavement conditions along S.E. Homestead Road.

TABLE 5
Existing Pavement Conditions

Station[(1)] Begin	End	Pavement Section[(2)]	Pavement Condition	Subgrade Soils[(3)]
690+00 I-90 38E	704+00	Type C with new 2 to 3 inch AC layer	Localized edge cracking.	Native
704+00	708+00	Type A and 2 to 3 inch AC overlay (old WB lanes)	Longitudinal crack at outside edge of WB lanes stations 705 to 706 (edge of old PCC pavement). Occassional transverse reflective cracks.	Native
708+00	712+00	Type A and 2 to 3 inch AC overlay (old WB lanes)	Occasional transverse reflective crack. Standing water within 1 foot of AC surface on south side of road between stations 709 to 710.	Fill
712+00	726+00	Type B and 2 to 3-inch AC overlay (old WB lanes)	Some minor rutting and persistent localized low severity longitudinal cracking in EB and WB lanes.	Fill
726+00	730+00	Type E and 2 to 3-inch AC overlay (old WB lanes)	Some minor rutting and persistent localized low severity longitudinal cracking in EB and WB lanes. Some longitudinal cracks at edge of old PCC.	Fill
730+00	732+00	Type E and 2 to 3-inch AC overlay (old WB lanes)	Some minor rutting and persistent localized low severity longitudinal cracking in EB and WB lanes. Some longitudinal cracks at edge of old PCC.	Native
732+00	751+00	Type D and 2 to 3 inch AC overlay (old EB lanes)	Occasional transverse reflective cracks.	Fill
751+00	760+00	Type D (old EB lanes)	Several low to moderate severity diagonal and corner break cracks. Few depressed panels. Panel joints generally tight.	Native
760+00	765+00	Type D (old EB lanes)	Several low to moderate severity diagonal and corner break cracks. Few depressed panels. Panel joints generally tight.	Fill
765+00	772+00	Type D and 1 to 2 inch AC overlay (old EB lanes)	Several cracked panels and local edge cracking.	Native
772+00	780+00	Type A and 2 to 3 inch AC overlay (old EB lanes)	Transverse reflective cracking and edge cracking. Ponded water on north side of road.	New Fill

780+00	800+00	Type A and 2 to 3 inch AC overlay	Good.	Native
800+00	I-90 38W	AC	Localized low severity longitudinal cracks in traffic lane and local edge cracking.	Native ?

Notes: (1) Stations are approximate and based on a comparison of existing site features and State Route No. 2 construction contract drawings.
(2) See Table 1 for Type A, B, C, D pavement section descriptions.
(3) New fill refers to material placed to modify SR 2 to the current S.E. Homestead Rd alignment.

In general the existing pavements are in good condition. The AC overlay was frequently cracked and slightly rutted in the traffic lanes and occasional transverse reflective cracks from the underlying PCC panels were commonly observed. Some of the PCC pavement panels were cracked although the panel joints were tight. The edge of the paved shoulders was cracked in several locations.

Traffic Conditions

The history of traffic loading on the existing highway and on the subsequent overlays is unknown. Additional traffic impacts to S.E. Homestead Road due to gravel pit operations are summarized in Table 6.

TABLE 6
Estimated Average Daily Trip Generation Rates [1]

Vehicle Type	Daily Trips(2)
Gravel Pit Operations:	
Gravel Trucks [2]	40
Concrete trucks [3]	12.5
Asphalt trucks [4]	33 1/3.
Public Traffic:	
Passenger vehicles	175
Commercial trucks	20

Notes:
(1) Reference URS/Dames & Moore, 2000.
(2) Gravel truck carries 25 tons
(3) Concrete truck carries 8 cubic yards
(4) Asphalt truck carries 30 tons

Based on these values, the expected number of equivalent 18-kip single axle loads (ESWL) will be about 1,000,000 in 20 years.

Engineering Analyses

Two pavement sections were evaluated to determine structural adequacy: (1) full 6-inch AC pavement section and; (2) full 8-inch PCC section. In all cases we assumed a subgrade CBR value of 20 and a corresponding AASHTO soil support S-value of 6.0 and subgrade modulus, k of 250 pound per cubic inch based on our understanding of the original construction methods and the performance of the existing roadway. The layer coefficient for the existing AC pavement was reduced from 0.45 to 0.30 to account for visible deterioration of the pavement.

Our analyses indicate that the full AC pavement sections are structurally adequate for the anticipated vehicle loads. For the predicted traffic loads, the existing AC pavement life is expected to be about 15 to 20 years.

The full depth PCC pavement sections that are not cracked have adequate structural capacity for the predicted traffic loads in the next 10 to 15 years. Roadway sections with cracked panels are expected to have shorter design life. PCC pavement sections with a 2 to 3-inch overlay were assumed to be adequate since the PCC pavemenets without an AC overlay were found to be adequate. Our assumption of the good condition of the underlying PCC pavement was based on observation of adjacent PCC pavements in the westbound lanes of State Highway No. 2. It appears that portions of the PCC pavement were overlain with AC to adjust the transverse profile of roadway curves and not due to pavement performance.

Discussion

In general the S.E. Homestead Rd. pavements have about 10 to 20 years of remaining design life for the anticipated traffic loads. The full depth AC pavements and the pavement sections consisting of PCC with an AC overlay are in better condition than the PCC pavements. Rehabilitation of the roadway could include repair of cracked PCC panels and placement of an AC overlay to meet current King County Standards. Transverse reflective cracks in the AC overlay could be sealed to reduce surface water infiltration. The subgrade and pavements at the roadway shoulders should be repaired to limit progressive failure of the edges of the pavement.

Surface water is currently well managed with drainage ditches and culverts except for short segments between about stations 709+00 to 710+00 and between about stations 772+00 to about 775+00. Ponded water in these areas should be drained away from the road subgrades. Continued routine maintenance of the drainage system will be required to prevent water ponding, saturation and weakening of the pavement subgrades.

The full life expectancy of the existing AC, PCC and, AC over PCC pavement sections depends on future roadway maintenance, past and future traffic volumes, and the strength and stiffness of existing subgrades and pavements. Since our evaluations of the existing pavements were based on visual observations and a review of construction records, the conclusions and recommendations presented in this report should be considered general in nature. Deficiencies in the road subgrade or pavement that were not visible at the time of our reconnaissance could result in premature failure of some roadway segments. Non-destructive in-situ testing, pavement coring, and laboratory testing would provide better information and an increased level of confidence in future roadway performance predictions.

Limitations

This report was prepared for the exclusive use of the owner, for specific application to the design of the project at this site as it relates to the geotechnical aspects discussed herein. The data, conclusions, and interpretations in this report should not be construed as a warranty of subsurface or pavement conditions described in this report.

Within the limitations of scope, schedule and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no other warranty, either express or implied. These conclusions and recommendations were based on our understanding of the project as described in this report and the site conditions as observed at the time of our site reconnaissance.

If there is a substantial lapse of time between the submission of this report and the start of construction at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, or appear to be different from those described in our report, we recommend that we review our report to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

REFERENCES

Washington State Highway Commission, (1953). "Primary State highway No. 2, Middle Crossing Snoqualmie River to Tanner, King County, King County." Washington State Highway Commission, Department of Highways, Olympia, Washington, April 1953.

URS/Dames & Moore, (2000). "Draft Environmental Impact Statement for North Bend Gravel Operation," King County Development and Environmental Services, Volume 1-DEIS, June 15, 2000.

ATTACHMENT C

SIGNAL WARRANTS

Signal Warrants

Signal warrant analysis was conducted on the intersection of 468th Avenue SE and SE 146th Avenue for the 2005, 2015, and 2025 with project traffic projections. Below is a short synopsis of the data used to determine whether the intersection meets the criteria for a signal at that location. Only the major aspects of each warrant are listed below. For a complete definition of each warrant refer to the Manual on Uniform Traffic Control Devices (MUTCD) millenium edition (2000) section 4C).

- Warrant 1: 8-hour vehicular volume: Considering a continuous 8-hour period does the volumes satisfy both a (1) minimum volume and (2) a minimum interruption of flow to allow for turning vehicles.

- Warrant 2: 4-hour vehicular volume: Considering a continuous 4-hour period does the volumes satisfy both a (1) minimum volume and (2) a minimum interruption of flow to allow for turning vehicles.

- Warrant 3: Peak Hour Vehicular Volume: Considering the peak hour do the volumes: (1) have a minimum amount of delay (2) have a minimum volume and (3) have a minimum total intersection volume.

- Warrant 4: Pedestrian Volume: Considers the number of pedestrians in the peak hour.

- Warrant 5: School Crossing: Considers the minimum and maximum of school age children per hour utilizing the intersection.

- Warrant 6: Coordinated Signal System: Considers the distance of near-by signalized intersections.

- Warrant 7: Crash Experience: Considers: (1) whether other measures have failed to reduce the crash frequency OR (2) whether five or more reported crashes occur within a 12 month period exceeding the applicable requirements for property damage, OR (3) whether the minimum number of vehicles exist for any 8 hour period.

- Warrant 8: Roadway Network: Considers the existing volumes as well as the 5 year projections for weekday and weekend traffic.

Table 1 shows the results for each of the warrants in the build scenario for the 2005, 2015, and 2025 analysis years. .

Table 1
Signal Warrant Analysis

Warrant	Short Description	Result	
		AM Peak	PM Peak
2005 Analysis			
Warrant 1	8-hour vehicular volume	No	No
Warrant 2	4-hour vehicular volume	No	No
Warrant 3	Peak Hour vehicular volume	No	No
Warrant 4	Pedestrian Volume	No	No
Warrant 5	School Crossing	Yes	Yes
Warrant 6	Coordinated Signal System	No	No
Warrant 7	Crash Experience	N/A	N/A
Warrant 8	Roadway Network	No	No
2015 Analysis			
Warrant 1	8-hour vehicular volume	No	No
Warrant 2	4-hour vehicular volume	No	No
Warrant 3	Peak Hour vehicular volume	No	No
Warrant 4	Pedestrian Volume	No	No
Warrant 5	School Crossing	Yes	Yes
Warrant 6	Coordinated Signal System	No	No
Warrant 7	Crash Experience	N/A	N/A
Warrant 8	Roadway Network	No	No
2025 Analysis			
Warrant 1	8-hour vehicular volume	No	No
Warrant 2	4-hour vehicular volume	No	No
Warrant 3	Peak Hour vehicular volume	No	No
Warrant 4	Pedestrian Volume	No	No
Warrant 5	School Crossing	Yes	Yes
Warrant 6	Coordinated Signal System	Yes	Yes
Warrant 7	Crash Experience	N/A	N/A
Warrant 8	Roadway Network	No	No

Noting that the Manual on Uniform Traffic Control Devices states that the satisfaction of one or more warrants does not in itself require the installation of a traffic control signal at that location, further study shows the warrants met are directly related to the building and operation of the proposed elementary and middle schools. With or without the construction of the project, this intersection may need to be modified to accommodate the number of students projected safely. Therefore, with the addition of trucks in the area, although increasing the possibility of more serious accidents, the safety of this intersection lies with the school district to try alternate measures such as crossing guards, warning signs and flashers, school speed zones, traffic calming devices, or a grade-separated crossing.